Chapter 1: Renewable Energy

Development of commercially viable renewable energy – wind, solar and geothermal - is increasing across the entire range of the sage-grouse, with current ~~concentrations~~ development in ~~some~~ areas already experiencing significant traditional energy development (e.g., MZs I and II; ~~) (~~EIA 2015, Entire; DOE, 2014, Entire; See Cumulative Effects section). There is little published scientific literature examining the effects of renewable energy on sage-grouse and sagebrush. Given the similarity in required infrastructure the effects of renewable energy development are likely similar to those of nonrenewable energy, specifically oil and gas. Renewable energy development is a relatively recent activity in sage-grouse habitats. For example, ~~While~~commercial wind energy in the United States began in the 1850s but~~,~~ it wasn't until 1992 with the onset of the Energy Policy Act, followed by the U.S. Department of Energy 20 percent Wind Energy by 2030 initiative in 2008, that wind energy production became ~~the number~~a large ~~one~~ source of renewable electricity (DOE 2014, entire). Development of renewable energy is specifically encouraged and/or required by several States. For example, the State of Idaho provides tax incentives and loan programs for renewable energy development (AFWA and Service 2007, p. 14) and Colorado law requires incremental increases of renewable generation from 3 percent in 2007 to 20 percent by 2020 (AFWA and Service 2007, p. 8).

Wind

Wind development is occurring throughout the range of sage-grouse (Table X-1, Figure X-1 ~~2~~), and ~~. O~~over 14 percent of the sagebrush landscape within the sage-grouse range have high potential for commercial wind power (BLM 2005, pp. 5-103; National Renewable Energy Laboratory [NREL] 2014, p. ?). Wind harvesting potentials are most concentrated and geographically extensive in MZs I and II, with areas of highest commercial potential including up to 40 percent of the available sagebrush

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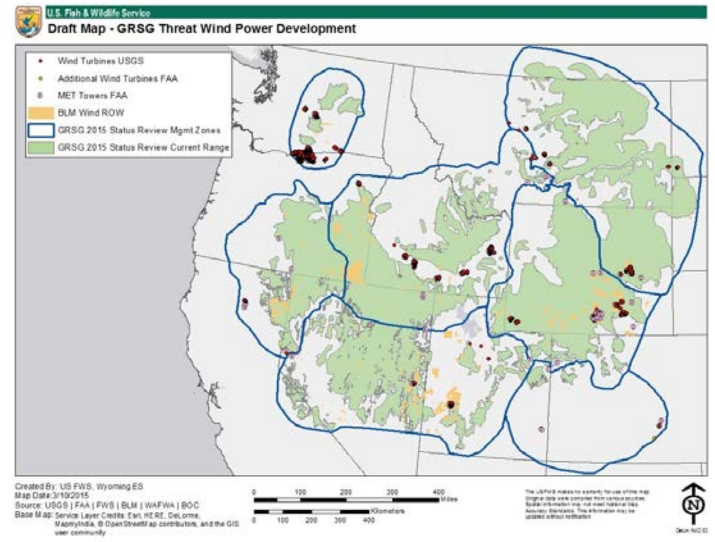
Formatted: Indent: First line: 0.5", Line spacing: Double habitats in these MZs. MZs III through VII each have approximately 1 to 14 percent of sagebrush habitats that are commercially viable for wind energy development (Figure X-1, Table ~~X-1~~X-1). While the BLM manages more land areas of high wind resource potential than any other land management agency currently developed wind energy facilities are located primarily on private lands (72 percent). ~~However~~Only~~,~~ 21 percent of wind energy developments are located on BLM-administered lands.

Table ~~11-5~~X-1: Area of sagebrush habitat with wind energy development potential by management zone (Data from Service 2014)

Comment [DP2]: need a better reference - what is Service 2014 - publication or GIS data?

SAGE-GROUSE MZ	Area of Sagebrush with Developable Wind Potential		
	km2	mi2	Percent of MZ
I	141937	54802	40.42
II	56275	21728	23.07
III	3880	1,498	1.22
IV	12,703	4,905	3.92
V	6,365	2,457	3.91
VI	1,528	590	2.36
VII	19	7	0.01
Total	222,708	85,988	13.74

Figure X-1: Current wind developments, and potential areas of development based on wind speed, etc.



Comment [DP3]: placeholder until get new map from GIS

~~Table X-1: Number of wind Turbines and footprint (km^2/acres) within Greater sage-grouse range as of 2013 (FWS 2015, p. ?). The footprint only indicates direct habitat loss from each individual turbine and does not consider the size of wind energy developments and their appurtenant facilities.~~

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~~Management Zone~~	~~Number of turbines~~	~~Footprint (km^2/acres)~~
~~I~~	~~392~~	~~4.72/1,167~~
~~II~~	~~583~~	~~6.73/1,664~~
~~III~~	~~110~~	~~1.33/328~~
~~IV~~	~~119~~	~~1.44/355~~
~~V~~	~~0~~	~~0~~
~~VI~~	~~0~~	~~0~~
~~VII~~	~~0~~	~~0~~

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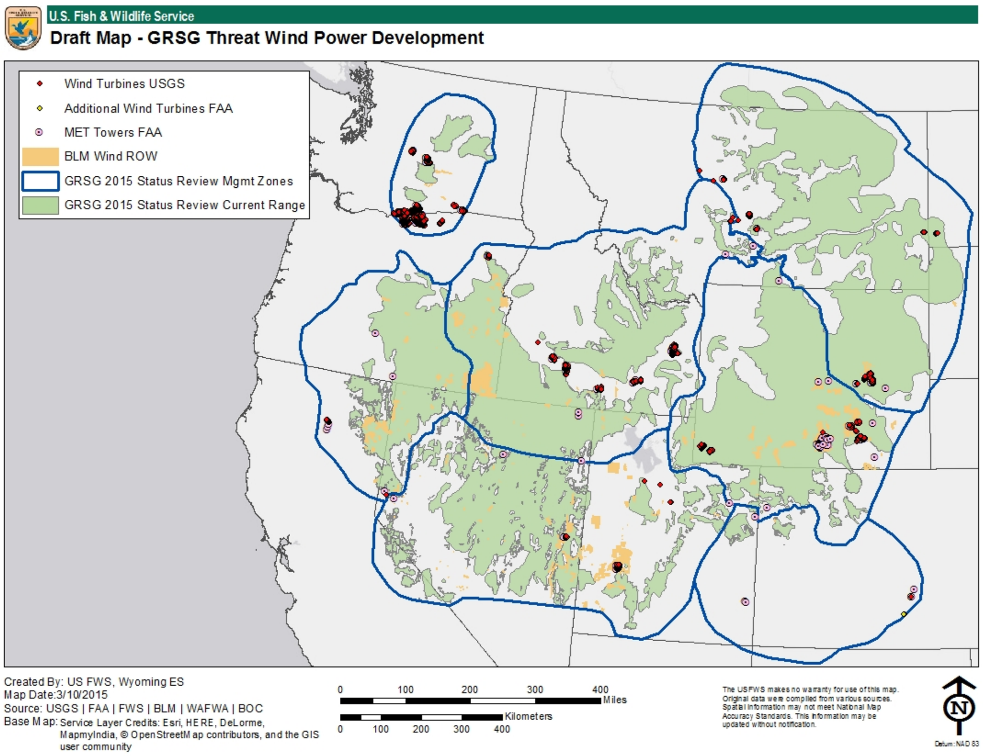

In 2005, the BLM completed the Wind Energy Final Programmatic EIS (PEIS) that provides an overarching guidance for wind project development on BLM-administered lands (BLM 2005a, entire). This EIS provided an avenue to accomplish the DOE's initiative to increase wind energy production by 20 percent by 2030 which was~~. This initiative is~~ designed to assist with the nation's energy demands while ~~and provide a form of energy production that does~~ not contribute~~e~~ing to climate change. Approximately 600 km^2 (232 mi^2) of BLM-administered lands are likely to be developed ~~in nine States~~ within the sage-grouse's range before 2025 (BLM 2005a, pp. ES-8, 5-2). This estimate could be conservative considering the interest in reducing green-house emissions (e.g. the DOE initiative) and the institution of State renewable energy mandates and incentives that have occurred since 2005. With the advent of Federal tax credits for wind energy facilities, wind development increased 20 percent in 2013 (Esterly and

Gelman 2013, p. 3). It is estimated that only 5 to 10 percent of a development will have a long-term disturbance that remains on the landscape for at least as long as the generating facility is viable (i.e., roads, foundations, substation, fencing) (BLM 2005a, p. 5-2). However, this estimate does not account for sage-grouse avoidance of developed areas and could underestimate indirect effects. The BLM wind policy permits granting private right-of-ways and leasing of public land for 3-year monitoring and testing facilities and long-term (30 to 35 years) commercial generating facilities (American Wind Energy Association (AWEA) 2008, pp. 4–24). Active leases for wind energy development on BLM-administered lands increased from 9.7 km^2 (3.7 mi^2) in 2002 to 5,113 km^2 (1,973 mi^2) in 2008, withand an additional 5,381 km^2 (2,077 mi^2) of lease requests were pending approval in the sage-grouse range (Knick -*et al*. 2011a, p. 244). The active lease areas cover thousands of acres (Knick *et al*. 2011a, p. 244) and the wind potential area covers tens of thousands of acres in occupied sage-grouse habitats (Table X-9). A recent increase in wind energy development is most notable within the range of the south-central Wyoming subpopulation of sage-grouse in MZ II where 1,387 km^2 (535 mi^2) have active wind leases and an additional 2,828 km^2 (1,092 mi^2) are pending (Knick- *et al*. 2011, p. 136). In mid-2009, wind energy production facilities in operation or under construction in the sage-grouse range had a capacity of 11.93 GW (AWEA 2009, entire). To achieve predicted levels of between 49 to greater than 90 GW capacity (DOE 2008, p. 10), the generation capacity would need to increase by 400 to 800 percent by 2030. Existing commercial wind turbines range from 1 to 4 MW generating capacity (AWEA 2013, entire). The forecasted increase in production would require approximately 37,000 to 78,000 or more turbines based on the existing technology and equipment in use (AWEA 2013, p. ?). To meet this capacity, an Assuming a generation capacity of 5 MW per km2 (0.4 mi2) density, Copeland *et al*. (2009, p. 1) estimated an additional 50,000 km^2 (19,305 mi^2) of land in the sage-grouse range would be required to meet the desired level of wind-generated electricity by 2030 (Copeland *et al*. 2009, p. 1). Interest in wind energy development is high, as reflected by the number of

Comment [DP4]: are these data still current?

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recently issued Right-of-Ways (ROWs) for wind on BLM lands (Table X-2).In addition to Wyoming, southeastern Oregon was a focus area for potential commercial-scale wind development. The BLM is the major land manager in southeastern Oregon, with jurisdiction over 49,000 km2 (18,900 mi2) (BLM 2009d, entire) that include much of the scantily vegetated ridge tops prone to high and sustained wind. At this time, most of the development activity is in the initial phase of meteorological site investigation and involves little infrastructure (AWEA 2009, entire; BLM 2009e, p. ?). If these monitoring sites are subsequently developed , fragmentation of this relatively intact sagebrush landscape could have negative impacts on sage-grouse. To date these potential areas in Oregon have not been developed, nor have developments occurred in MZ VI or VII (where there are also current locations of met towers). Turbines and ROW disturbance areas are currently in MZ I, II, III, and IV (Table X , Table X , and Table X).

Currently, the BLM and USFS are proposing to exclude wind development in priority habitats until such a time wind energy technology advances to the point that there are no impacts to sage-grouse populations. Some of these plans are extending this protection to ROW exclusion, which will permit no impacts in priority habitats due to wind and solar development. Associated transmission lines are addressed separately in the draft proposed RMPs, with some plans designating transmission corridors as exclusion areas (no new construction), while others will be avoidance areas (areas with more flexibility for development). Transmission lines and roads could still be constructed under an avoidance designation.

Wyoming, where wind development potential is high (MZ II), does not have a requirement for increased reliance on renewable energy sources and no specific wind siting authority. However, large commercial construction projects in the State are subject to compliance with the State's Core Area Strategy, as implemented by Executive Order 2011-5. This EO is designed to prevent harmful effects to sage-grouse from development or new land uses in designated core areas (PACs). Currently wind development is not permitted in PACs under this EO. While this EO is currently be revised, no changes to wind siting restrictions are anticipated. In Idaho wind power is currently unregulated at any level of government (AFWA and Service 2007, p. 14). The North Dakota Public Service Commission only regulates siting of wind power facilities with a capacity of greater than 100 MWs, but then only use the Service's interim voluntary guidelines (Service 2003, entire). OTHER STATES?

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This EIS provided an avenue to accomplish the DOE's initiative to increase wind energy production by 20 percent by 2030 . This initiative is designed to assist with the nation's energy demands and provide a form of energy production that does not contribute to climate change. Approximately 600 km2 (232 mi2) of BLM-administered lands are likely to be developed in nine States within the sage-grouse's range before 2025 (BLM 2005a, pp. ES-8, 5-2). It is estimated that only 5 to 10 percent of a development will have a long-term disturbance that remains on the landscape for at least as long as the generating facility is viable (i.e., roads, foundations, substation, fencing) (BLM 2005a, p. 5-2). However, this estimate does not account for sage-grouse avoidance of developed areas and could underestimate indirect effects. Based on what we know of oil and gas development (see the oil and gas chapter), the impact of infrastructure (see chapter X infrastructure), noise, and human activity can reach beyond direct footprint and contribute cumulatively to other human-made and natural disturbances that fragment and decrease the quality of sage-grouse habitats (Holloran 2005, p. 1; Pruett *et al.* 2008, p. 6, Patricelli *et al.* 2013, p.231). The BLM's determination of the quantity of lands potentially impacted by wind energy development could be conservative considering the interest in reducing green-house emissions and the institution of State renewable energy mandates and incentives that have occurred since 2005. Wind development is guided by policy at BLM national and State levels that generally offers only guidance to avoid impacts to sage-grouse and habitats. A 2008 BLM Instruction Memo IM 2009-43 and 2012-044

(BLM 2008e, p. 2) emphasizes the use of the Service's 2003 interim guidelines as voluntary and to be used only on a general basis in siting, design, and monitoring decisions. The BLM's Oregon State Office Instruction Memorandum OR-2008-014 (BLM 2007d, entire) is explicit in the placement of meteorological test towers to avoid active leks, seasonal concentrations, and collision; IM OR- 2009-038 (BLM 2009f, entire) reduces the Oregon Department of Fish and Wildlife's (ODFW) recommended buffer distance for wind farms and applies only guidelines for avoidance of sage-grouse leks and seasonal habitats (MZ V). Currently, the BLM and USFS are proposing to exclude wind development in priority habitats until such a time wind energy technology advances to the point that there are no impacts to sage-grouse populations. Some of these plans are extending this protection to ROW exclusion, which will cause no impacts due to wind and solar development, with the assumption that there will be no exceptions to these designations. Many of the plans have designated areas as avoidance for transmission lines, which may have ROW permits granted at any time in the future. The exclusion designation provides protections for sage-grouse with more guarantees, however under an avoidance designation may still construct transmission lines and roadways at any time.

A recent increase in wind energy development is most notable within the range of the south-central Wyoming subpopulation of sage-grouse in MZ II where 1,387 km2 (535 mi2) have active wind leases and an additional 2,828 km2 (1,092 mi2) are pending (Knick *et al.* 2011, p. 136). The BLM Final PEIS on Wind Energy Development (2005) underestimated the amount of development that would occur likely because the document was written before the 2008 DOE policy that wind will provide 20 percent of the nation's energy by 2030. In Wyoming, where wind development is advancing and predicted to increase by 10 fold or more (DOE 2008, p. 10), the effects of both conventional and nonconventional renewable sources may claim a substantial toll on sage-grouse habitats and geographic areas that were considered refugia for the species. Wyoming does not have a requirement for increased reliance on renewable energy sources and no specific wind siting authority. However, large commercial construction projects in the State are subject to approval by an Industrial Siting Council (ISC) of the State Department of Environmental Quality, with the Wyoming Game and Fish Department (WGFD) providing recommendations for mitigating impacts to wildlife associated with development considered by the ISC. The ISC's review and approval of projects is subject to the Wyoming Governor's executive order (State of Wyoming 2008, entire) that is intended to prevent harmful effects to sage-grouse from development or new land uses in designated core areas. Wind developers in Wyoming understand that most proposed wind developments, regardless of locale, must be approved by the ISC and that development proposed in core areas is unlikely to be permitted by the ISC due to the Governor's Executive Order. Although Wyoming does not have a requirement for increased reliance on renewable energy sources most of the energy produced is being transported to state's where there is a requirement for increased reliance on renewable energy sources, such as Nevada. This is evident with proposals for cross country transmission lines projects, such as the transwest express and the gateway west and south (see chapter X infrastructure for more information).

In addition to Wyoming, southeastern Oregon was a focus area for potential commercial-scale wind development. The BLM is the major land manager in southeastern Oregon, with jurisdiction over 49,000 km2 (18,900 mi2) (BLM 2009d, entire) that include much of the scantily vegetated ridge tops prone to high and sustained wind. At this time, most of the development activity is in the initial phase of meteorological site investigation and involves little infrastructure (AWEA 2009, entire; BLM 2009e, p. ?). If these monitoring sites are subsequently developed , fragmentation of this relatively intact sagebrush landscape could have negative impacts on sage-grouse. To date these potential areas in Oregon have not been developed, nor have developments occurred in MZ VI or VII (where there are also current locations of met towers). Turbines and ROW disturbance areas are currently in MZ I, II, III, and IV (Table X , Table X , and Table X).

Although development of renewables is encouraged at the State level, siting authority for wind varies from State to State (AFWA and Service 2007, pp. 7, 8, 14, 28, 30, 36, 39, 43, 46, 49, 52; State of Oregon 2008, entire). For example, the State of Idaho provides tax incentives and loan programs for renewable energy development, but wind power is currently unregulated at any level of government (AFWA and Service 2007, p. 14). Colorado law requires incremental increases of renewable generation from 3 percent in 2007 to 20 percent by 2020 (AFWA and Service 2007, p. 8). Financial incentives, including grants and tax breaks, encourage private development of renewable sources. The North Dakota Public Service Commission regulates siting of wind power facilities over 100 MWs using the Service's interim voluntary guidelines (Service 2003, entire). The push for renewable energy development has led to proposals and wind energy developments that can occur within the current range of sage-grouse, at times disturbing large expanses of priority sage-grouse habitats.

Mud Spring Wind Ranch has announced the start of construction on its four-phase 240 MW, 120-turbine project on private land in Carbon County, Montana, which includes substation and transmission line construction. The lease size is approximately 10,049 ha (24,832 ac). This project location occurs in a PAC (as identified in the 2013 COT Report; Wyoming Basin population) and core sage-grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

Montana-Dakota Utilities constructed, owns and operates the 30-MW Diamond Willow wind farm in Fallon County near Baker, Montana. Constructed in three phases between approximately 2007 and 2010, this wind farm consists of 20 1.5 MW wind turbines. This project occurs in a PAC (Dakotas population) and core sage-grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

Table X-5 FAA MET Towers and Total Footprint within GRSG 2015 Status Review Current Range

Management Zone	Number of MET Towers	MET Tower Footprint Acres	% of Current Range
I	9	27	0.00%
II	34	101	0.00%
III	2	5	0.00%
IV	6	18	0.00%
V	1	3	0.00%
VI	0		
VII	1	3	0.00%
Total:	53	157	0.00%

Source: (Service 2015, p. ?)

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Table X-2: Area of 6 Wind BLM Wind Right-of-Way (ROWs) within GRSG 2015 Status Review Current Range (FWS 2015)

Comment [DP5]: This needs to be checked with the GIS folks. Also, we say MZ i and II are at most risk, but here the ROWs say its MZ 3-5. Needs resolution.

Management Zone	BLM Wind ROW Footprint (km^2/ Aacres)
I	9.8/2,414
II	1541.3/380,869
III	2064.4/510,126
IV	3038.7/750,882

V	4031.4/996,182
VI	1.1/278
VII	114.5/28,293
~~Total:~~	~~2,669,044~~

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~~**Source: (Service 2015, p. ?)**~~

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~~**The Energy Policy Act (Public Law 109–58, August 8, 2005) established a goal for the Secretary of the Interior to approve 10,000 megawatts (MW) of electricity from non-hydropower renewable energy projects located on public lands. States are also encouraging the development of renewable energy. For example the State of Nevada, through the Renewable Portfolio Standard, has mandated that investor-owned utilities generate, acquire, or save 20 percent of their produced electricity from renewable systems by 2015.**~~

Solar

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The BLM manages more than 7 million ha (19 million ac) of public lands with excellent solar energy potential in 6 states: California, Nevada, Arizona, New Mexico, Colorado, and Utah (BLM 2014c). In 2012 the BLM finalized the Western Solar Plan for development on their lands, providing a blueprint for utility-scale (20 MW or more) solar energy permitting and associated transmission connections to existing electricity transmission grids within the 6 western States. ~~The Western Solar Plan also established seventeen Solar Energy Zones (SEZs) – areas where the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development.~~

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~~As a result, decisions on projects that are less than 20 MW would continue to be made in accordance with existing land use plan requirements, current applicable policy and procedures, and~~

individual site-specific NEPA analyses. To meet the objectives of BLM's sage-grouse conservation policy, the associated Solar PEIS for Energy Development (2012, entire) has excluded specifically identified sage-grouse habitat (currently occupied, brooding, and winter habitat) located on BLM public lands in Nevada and Utah (the only area of overlap with sage-grouse). Draft EIS for the current BLM/FS planning efforts indicate that solar developments are excluded in priority sage-grouse habitats (generally PACs). Therefore, any commercial development of solar projects within the range of sage-grouse on Federal lands will be limited to general sage-grouse habitats. Smaller facilities (<20 MW) on BLM lands would be developed under the criteria established within each local BLM Resource Management Plans.

These exclusions will be subject to change based on the outcome of the BLM's sage-grouse planning efforts and resulting plan amendments (BLM 2012, p. E-10). Solar energy systems require, depending on local conditions, 1.6 ha (0.016 km^2, 4 ac) to produce 1 MW of electricity. The BLM/USFS under the sage-grouse RMP amendment EISs are excluding or avoiding solar developments within sage-grouse priority habitats (Table X-5), therefore these actions should be happening outside of sage-grouse priority habitats. Viable utility-scale solar technologies considered likely to be deployed over the next 20 years (i.e., until about 2030) and analyzed as part of the Solar PEIS include parabolic trough, power tower, dish engine systems, and photovoltaic (PV) systems (BLM 2012, p.1-5).

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There are currently four no commercial solar plants are operating in sage-grouse habitats (Figure X-2, Table X-3; MZ III and IV; FWS GIS data). . The PEIS for Solar Energy Development (2012) identified specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM proposes to prioritize development (and to apply any identified SEZ-specific design features), in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and Utah). Solar Energy Zone are defined by the BLM

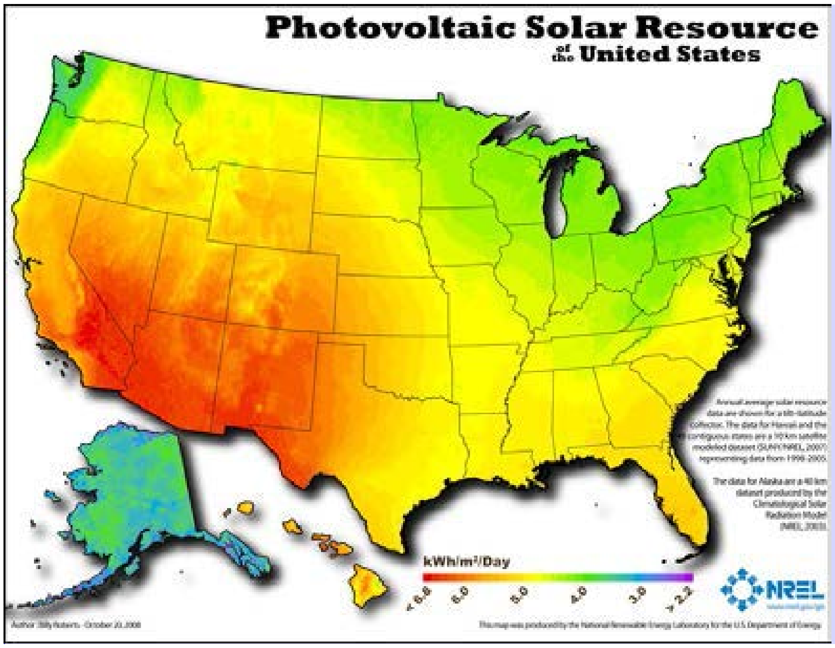
~~There are currently no ROWs permitted for solar energy facilities in the planning area (BLM, 2013h, p.3-99).~~

~~The planning area has had no activity regarding solar energy projects, but this could change in the future (BLM, 2013k, p. 413).~~

~~No commercial solar plants are operating in sage-grouse habitats at this time. The PEIS for Solar Energy Development (2012) identified specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM proposes to prioritize development (and to apply any identified SEZ-specific design features), in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and Utah). Solar Energy Zone are defined by the BLM as an area within which the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development. SEZs should be relatively large areas that provide highly suitable locations for utility-scale solar development: locations where solar development is economically and technically feasible, where there is good potential for connecting new electricity-generating plants to the transmission distribution system, and where there is generally low resource conflict (BLM, 2012, ES-7,8).~~

Comment [DP6]: Is this in just one specific planning area or the entire sage-grouse range? It seems this statement conflicts with the table below that says there are plants in at least 3 MZs

Comment [DP7]: this conflicts with GIS data - needs resolution.



From NREL, 2010

~~Table 11-1: Solar Plants within GRSG 2015 Status Review Current Range Source: (Service 2015, p. ?)~~

~~Management Zone~~	~~Number of Plants~~	~~MW~~
~~1~~		
~~2~~		
~~3~~	~~1~~	~~1~~
~~4~~		
~~5~~	~~1~~	~~4.95~~
~~6~~		
~~7~~		
~~Total:~~	~~2~~	~~5.95~~

Comment [DP8]: This is a placeholder for the map coming re: solar potential and MZs.

Comment [DP9]: This table makes no sense given the associated text. Are there really plants within the range of grouse, or are they simply in those MZ. I would suggest deleting the tables regardless, and just describing this in text if there are existing plants.

Comment [DP10]: need to get data from GIS folks for this table. Depending on the map, the table may not be necessary unless it reflects footprint.

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Table 11-2: Solar Plant Footprints within GRSG 2015 Status Review Current Range Source: (Service, 2015) Solar Plant Footprint = 62 meter buffer of Solar Plant point data

Management Zone	Plant Footprint Acres	% of Current Range
1		
2		
3	3	0.00%
4		0.00%
5	3	
6		
7	-	-
Total:	6	0.00%

Geothermal

The greatest -potentials for commercial hottest geothermal energy development resources and where commercial electrical generation would most likely occur, are generally within MZ III, IV, and V (EIA 2009e, entire; Fig X-3). Currently, approximately 1,800 km^2 (694 mi^2) of active geothermal leases exist on public lands primarily in the Southern (MZ IV) and Northern Great Basin (MZ III) and 1,138 km^2 (439 mi^2) of leases are pending (Knick *et al.* 2011, p. 245). Nevada is predicted to experience the greatest increase in geothermal growth across the United States–doubling production from geothermal sources by 2025 (BLM and U.S. Forest Service (USFS) 2008b, p. 2-35).

Figure X-3: Geothermal Energy potential...

The BLM has the authority to lease geothermal resources in 11 western States (eight of which occur within the current sage-grouserange). A programmatic EIS for geothermal leasing and operations was completed in 2008 (BLM and USFS 2008a, entire). Best management practices for minimizing the effects of geothermal development and operations on sage-grouse are guidance only and are general in nature

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Comment [DP11]: I tried to update this with the BER. But running into totally different numbers. I think the difference is the baseline calculations, and whether or not all lands are included. So I did not change this text.

Comment [DP12]: This figure will be combined with the one below. May also add a table of geothermal facilities.

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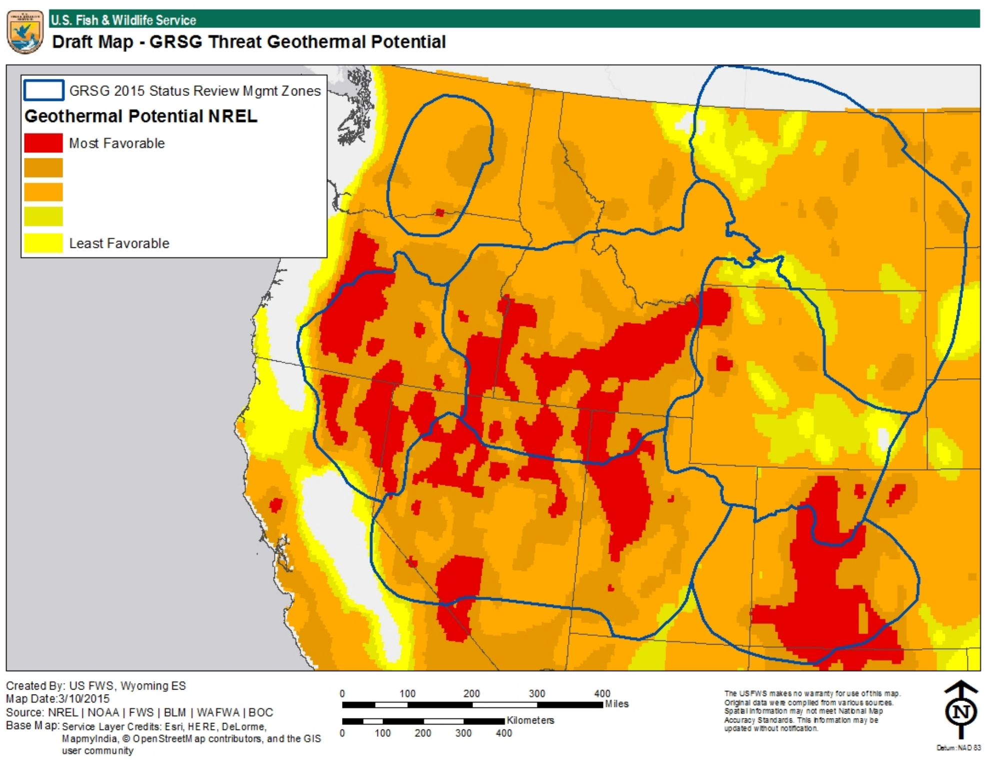
~~(BLM and USFS 2008a, pp. 4.82–4.83). Some of the BLM/USFS under the sage-grouse RMP amendment EISs are closing sage-grouse priority habitats to geothermal development, however many are allowing development under the lease stipulations outlined for fluid mineral development Table X-5). The EIS' reasonably foreseeable development scenario predicts that Nevada will experience the greatest increase in geothermal growth–doubling the production of electricity from geothermal sources by 2025 (BLM and USFS 2008, p. 2-35). Currently, approximately 1,800 km2 (694 mi2) of active geothermal leases exist on public lands primarily in the Southern (MZ IV) and Northern Great Basin (MZ III) and 1,138 km2 (439 mi2) of leases are pending (Knick *et al*. 2011, p. 245). See the location and extent section for a map of the current geothermal leasing areas.~~



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The BLM has the authority to lease geothermal resources in 11 western States, eight of which are within current sage-grouse range. A programmatic EIS for geothermal leasing and operations was

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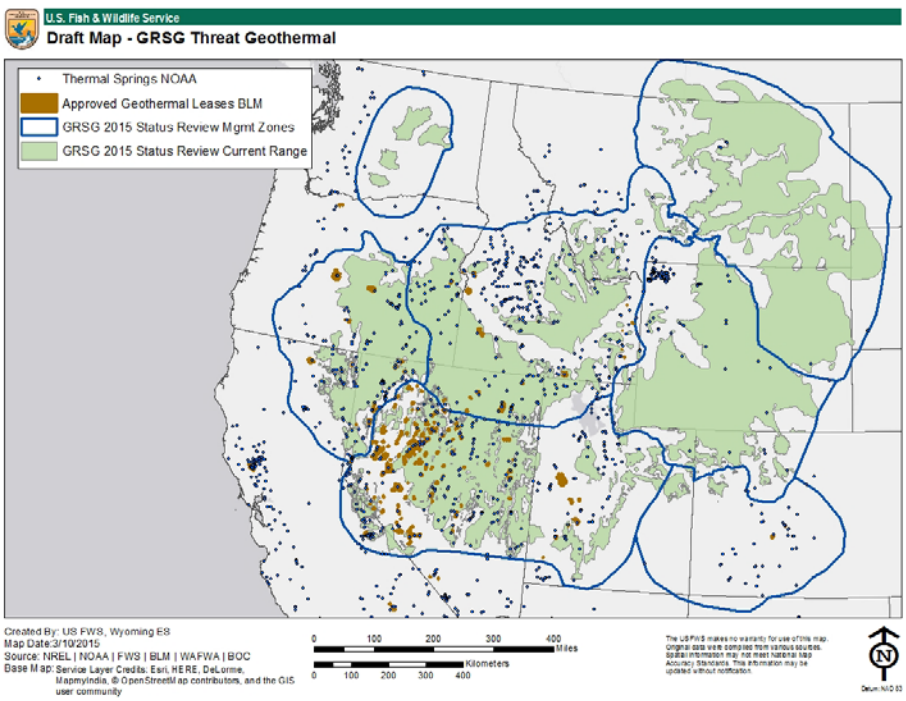
Comment [DP13]: figure coming from GIS folks completed in 2008 (BLM and USFS 2008a, entire), containing best management practices (BMPs) for minimizing the effects of geothermal development and operations on sage-grouse. The BMPs are general and guidance only (BLM and USFS 2008a, pp. 4.82–4.83). The proposed draft BLM/FS plan amendments have subsequently closed priority sage-grouse habitats to fluid mineral development (which includes geothermal) or will be imposing major constraints, such as no surface occupancy restrictions. General sage-grouse habitats will still be open for development, although many RMPs will still impose moderate constraints (e.g. buffers, seasonal closures). Currently there are 4 geothermal facilities within the range of sage-grouse (Figure X-3; MZs III and IV; FWS GIS data).

Figure X-3: Geothermal facilities and leases within the range of sage-grouse.



~~Table 11-3: Geothermal Power Plants within GRSG 2015 Status Review Current Range Source: (Service 2015, p. ?)~~

Comment [DP14]: placeholder. Will be only one map (hopefully) reflecting both potential and locations of facilities.

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Comment [DP15]: definitely need to combine the tables if there are active geothermal plants in the range. However, the numbers in table 11-4 don't make sense.

Management Zone	Number ofGeothermal Plants
1	0
2	0
3	2
4	1
5	0
6	0
7	0
Total:	3

Comment [DP16]: Need to resolve with GIS data

Table 11-4: Power Plant Footprints within GRSG 2015 Status Review Current Range Source: (Service, 2015) * Geothermal Power Plant Footprint = 62 meter buffer of Geothermal Power Plant point data

Management Zone	Power Plant Footprint Acres	Percent of Current Range
1	0	0.00%
2	0	0.00%
3	6	0.00%
4	3	0.00%
5	0	0.00%
6	0	0.00%
7	0	0.00%
Total:	9	0.00%

Current impacts

Mechanism

Studies examining the impacts of renewable energy development on sage-grouse populations are limited. Renewable energy facilities typically require many of the same features for construction and operation as do nonrenewable energy resources and therefore we anticipate the impacts will be similar. This includes direct habitat losses and habitat fragmentation through construction and operation of an energy facility, and indirect effects resulting from the presence of powerlines, human activity, introduction of invasive weeds and novel predators, and noise (Connelly *et al*. 2004, pp. 7-40 to 7-41; Holloran 2005, p. 1; Pruett *et al.* 2008, p. 6, Patricelli *et al*. 2013, p.231; Howe *et al* 2014, p. 46; reference Oil & Gas, Mining, and Infrastructure Chapters for more detail).

~~Connelly *et al*. 2004, pp. 7-40 to 7-41Studies examining the impacts of renewable energy development on sage-grouse populations are limited. Renewable energy facilities typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly *et al*. 2004, pp. 7-40 to 7-41) will generally be similar to those discussed for nonrenewable energy development (see Oil & Gas, Mining, and Infrastructure Chapters).~~

~~e . The primary concern are the direct effects of energy development on the long-term viability of sage-grouse by eliminating habitat, leks, and fragmenting some of the last remaining large expanses of habitat necessary for the species' persistence.~~

~~Renewable energy facilities typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through construction of roads and powerlines, noise, and~~

increased human presence (Connelly *et al.* 2004, pp. 7-40 to 7-41) will generally be similar to those already discussed for nonrenewable energy development (see Oil & Gas, Mining, and Infrastructure Chapters).

Wind

Wind generating facilities have increased in size and number, outpacing development of other renewable energy sources within the sage-grouse range. Although wind energy has been the fastest growing energy technology worldwide, achieving an annual growth rate of over 30 percent (BLM, 2014b), wind turbine construction within the sage-grouse range peaked in 2009 with 335 turbines constructed. Construction subsequently declined followed by an increase from 2012 to 2013 (Table X-).

From a landscape perspective, tThe average footprint of an individual wind turbine unit is relatively small (0.004 – 0.12 km^2 [1 – 3 acres]; BLM 2005a, pp. 3.1–3.4), but large-scale wind farm developments also require powerlines, roads, power substations, meteorological towers and sometimes office and work facilities. The number and spacing of turbines, which influences the size of the entire wind development (and therefore the amount of direct and indirect habitat loss) and need for appurtenant facilities is directly impact sagebrush habitats by reducing and fragmenting them and increasing noise levels and roads in areas that were previously undeveloped (Holloran 2005, p. 11; Patricelli *et al.* 2013, p. 230). Additionally, wind developments can indirectly degrade sagebrush habitats by introducing invasive plants and providing pathways for predators (Howe *et al* 2014, p. 46).

Turbines arelargely based on local installed after the meteorological data. indicate the appropriate siting and spacing. Roads are necessary to access the turbine sites for installation and maintenance. Each turbine unit has an estimated footprint of 0.4 to 1.2 ha (1 to 3 ac) (BLM 2005a, pp. 3.1–3.4). One or more substations may be constructed depending on the size of the farm. Substation footprints are 2 ha (5 ac) or less in size (BLM 2005a, p. 3.7). Turbines require careful placement within a field to avoid loss

~~of output from interference with neighboring turbines. Spacing improves efficiency but expands the overall footprint of the field.~~

Most published reports of the effects of wind development on birds focus on the risks of collision with towers or turbine blades (Pruett ~~-~~*et al.* 2009, p. 013136). Sage-grouse could be killed by flying into turbine rotors or towers (Erickson *et al.* 2001, entire) although reported collision mortalities have been few; average tower heights, flight elevations of sage-grouse, and diurnal migration habitats minimize the risk of collision. ~~One sage-grouse was found dead within 45 m (148 ft) of a turbine on the Foote Creek Rim wind facility in south-central Wyoming, presumably from flying into a turbine (Young *et al.* 2003, Appendix C, p. 61).~~ At wind farms in Wyoming, there have been 8 reported sage-grouse collision mortalities from 2009 through 2012, including one collision with an associated ~~met~~meteorological tower ~~located near a wind farm~~ (USFWS 2015, pers. comm.). These data could be an underestimate of actual mortality ~~However,~~ due to the sampling design for estimating ~~predicting~~avian mortality in wind farms, and ~~rates for these project areas, only a subset of the turbines were monitored for collision mortalities. Approximately, 30 percent of the turbines were searched, and searcher efficiency was approximately 60 to 70 percent.~~ scavenging of carcasses by predators prior to detection ~~In addition, sage-grouse are more likely to be scavenged and removed from the search area before the search is conducted, it is unclear what level of mortality rates these fatalities represent~~ (USFWS 2015, pers. comm.). For- sage-grouse, the highest collision probabilities appear to occur when structures are located in areas where sage-grouse typically fly between foraging and loafing habitats. ~~If the locations of such areas are known, impacts can be reduced by avoiding these areas when siting wind energy facilities~~ (Johnson and Holloran 2010, p. 9). ~~Preliminary data from research in Wyoming has indicated that direct mortality from collision occurs and may be greater than previously anticipated (USFWS 2015, pers. comm.).~~

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~~LeBeau *et al.* (2014. p. ?) documents the short-term effects of wind energy infrastructure on sage-grouse habitat selection and on nest, brood, and female survival.~~ At a wind facility in Wyoming ~~F~~female survival did not appear to be related to distance to turbines, unlike ~~which is counter to~~ research results from ~~conducted in~~ natural gas fields for sage-grouse and prairie-chickens (L~~e~~eBeau *et al.* 2014, p. 528). ~~This is likely related to high site fidelity inherent to sage-grouse (LeBeau *et al.*, 2014, p. 2).~~ However, ~~S~~sage-grouse nest and brood survival did decrease~~d~~ in habitats in close proximity to wind turbines, ~~. Decreased nest and brood survival was~~ likely the result of increased predation, which may have been a product of anthropogenic development and habitat fragmentation (Le~~a~~Beau *et al.* 2014, p. 522). Primary sage-grouse nest predators may be attracted to wind energy developments because of subsidized food resources from deaths of birds by turbines, combined with low levels of human activity (LeBeau *et al*. 2014, p. 528).

Sage-grouse and Greater and Lesser prairie chickens (*Tympanuchus cupido* and *T. pallidicinctus*, respectively) ~~Sage-grouse are nesting in less risky habitats farther away from potential perches and in areas that have lower densities of small, medium, and large avian predators (Dinkins *et al.* 2014, p. 629). Despite sage-grouse fidelity, adult females with failed nests from the previous nesting season had lower nest site fidelity compared with females with successful nests. As in previous findings in response to disturbance, yearling birds had relatively larger changes in their spatial locations than adult birds whose spatial changes were at a smaller scale (Dinkins *et al.* 2014, p. 638). Sage-grouse habitat use patterns could be explained by areas of relatively greater predation over time leading to low sage-grouse productivity (Dinkins *et al.* 2014, p. 638). Sage-grouse are using direct and indirect mechanisms to avoid predators in habitat selection, possibly partially lowering their exposure to predation and nest predation (Dinkins *et al.* 2014, p. 629).~~

Comment [DMD19]: Does LeBeau et al.'s research include other prairie grouse? Need to cite the appropriate literature here.

Comment [DP20]: LeBeau does discuss other prairie grouse in this article.

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The aavoidance of human-made structures such as powerlines and roads by sage-grouse and lesser and greater prairie-chickens has been documented (e.g.,Holloran 2005, p. 1; Pruett *et al.* 2008, p. 6). New powerlines and possibly other tall structures, such as wind turbines, may be avoided in previously suitable habitats and serve as barriers to movement (Pruett -*et al.* 2008, p. 01313832, and references therein). Habitat fragmentation could potentially negatively affect demographic rates due to increased risk of predation or energy use (Gibson *et al.* 2013, p.2). -If habituation to new disturbance does not occur, population level response could contribute to behavioral avoidance to wind development resulting in functional habitat loss (Winder -*et al.* 2014, p.11).). Sage-grouse female and nest survival has been linked to the distance from transmission lines (Gibson *et al.* 2013, p.27). Sage-grouse selected habitat locations farther away from landscape attributes that could be used as perches or provide subsidized food sources for predators at all reproductive stages, power lines at brood locations, and major roads and riparian habitat at nest locations (Dinkins *et al.* 2014, p.639). Habitat fragmentation could potentially negatively affect demographic rates due to increased risk of predation or energy use (Gibson *et al.* 2013, p.2). Nests in fragmented habitats were 9 times more likely to be depredated as those in continuous habitats, and the majority of nests in fragmented habitats were depredated by corvids (Vander Haegan *et al.* 2002, Howe *et al.* 2014, p.45).

In addition, meso-carnivore mammals and corvids, primary sage-grouse nest predators, may be attracted to wind energy developments because of subsidized food resources from deaths of birds by turbines, combined with low levels of human activity, whereas predators that prey on adults (e.g., golden eagles (*Aquila chrysaetos*) may not (LaBeau *et al.* 2014, p. 528). Ongoing land use changes suggest there will be further increases in raven abundance (see the predation chapter for more information) in these fragmented sagebrush-steppe habitats (Howe *et al.* 2014, p. 44). Human manipulation of habitat that promotes increased densities of avian predators may limit sage-grouse

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populations, because habitat that has high quality cover and forage may become functionally unavailable to sage-grouse as avian predator densities increase (Dinkins *et al.* 2014, p. 640).

Noise is produced by wind turbine mechanical operation (gear boxes, cooling fans) and airfoil interaction with the atmosphere. Although recent research demonstrates negative there has been recent research demonstrating the effects of noise from natural gas developments on sage-grouse (e.g. Patricelli et al. 2013, entirecitations?), there have beenare no published studies focused specifically on the effects of wind power noise and sage-grouse. However, other types of anthropogenic noise sources (e.g., infrastructure from oil, geothermal, and mining, as well as wind development, off-road vehicles, highway traffic, and urbanization) are similar in acoustic frequency, amplitude, and timing, and response by sage-grouse to these other noise sources may be similarto those observed at natural gas developments (Patricelli *et al.* 2013, p.231). In studies conducted in oil and gas fields, noise affected may have played a factor in sage-grouse abundance, habitat selection and decrease in lek attendance (Holloran 2005, pp. 49, 56) and also increases stress . Recent noise research has demonstrated noise from natural gas development negatively impacts sage-grouse and alters breeding behavior abundance, stress levels, and behaviors (Patricelli *et al*. 2013, p. 231). Sage-grouse do not appear to habituate to anthropogenic noise over time (Patricelli *et al*. 2013, p. 231). Noise from natural gas development primarily is produced by drilling rigs, compressors, generators, and traffic on access roads. All of these noise sources are loudest in frequencies (i.e. pitch) <2.0 kHz. Male sage-grouse produce signals in a similar frequency range between 0.2 and 2.0 kHz, the potential exists for industrial noise to mask sage-grouse communication, interfering with the ability of females to find and choose mates. Noise may also increase predation risk by masking the sounds of approaching predators and increasing stress levels by increasing the perception of predation risk. In other vertebrate species noise has been found to impact individuals directly, by causing startling behaviors, increasing the heart rate, or increasing annoyance (Patricelli *et al.* 2013, p.231). All of these factors may interfere with normal foraging, resting, and breeding behaviors and contribute to higher stress levels and reduced fitness (Patricelli -*et al*. 2013, p. 231).

Immediate and sustained declines in male attendance was observed on leks where 29 percent of the decline was due to drilling noises and 73 percent of the decline was due to traffic noises, with similar declines in female lek attendance (Patricelli *et al*. 2013, p. 231). There was evidence of elevated corticosteroid levels associated with increased physiological stress suggesting that males that did not physically abandon the lek were physiologically impacted. In addition, males altered the timing of their vocalizations in response to noise, increased display rates during close courtship on leks with drilling noise, and waited for gaps of quiet on leks with vehicle noise (Patricelli *et al*. 2013, p. 231). Sage-grouse do not appear to habituate to anthropogenic noise over time. The declines in male attendance observed in this study was immediate and sustained throughout the 3-year study period. Elevated stress hormones were observed in both second and third years of noise playback indicating that sage-grouse do not adapt to increased noise levels over time (Patricelli *et al*. 2013, p. 231).

The footprint of associated powerlines is 200 m (100 m on either side of the powerline) (Mariner *et al*. 2013, p. 44).

Recently there has been indication of wind turbines creating microclimates. This has been particularly evident in offshore turbine facilities. However, research in Iowa to has also found that terrestrial wWind turbines can change the microclimate by generatinged changes in mean wind, pressure, and turbulence resulting in potential changes in and may influence heat fluxes of heat, moisture, and CO_2 (Rajewski *et al*. 2013, p. 655). DThe changes in ifferences in microclimate are known to persist up to 15 rotor diameters (1,372m [4,500 ft]) downwind of a wind turbine, potentially resulting in vegetative changes extending beyond the habitat loss associated with direct footprint of a wind farm-. Increasing CO_2 does facilitate the spread of cheatgrass ((Chambers and Pellant 2008, p. 32; Global Climate Change Impacts in the United States 2009, p. 83).; see Invasives chapter for more detail). While changed in microclimates could affect sage-grouse habitat quality, Wwe do not know of any research demonstrating how wind turbine-generated microclimate changes will affect sagebrush ecosystems.

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Sage-grouse response to the construction of a wind facility may not be immediately obvious. The actual impacts of a facility may not be realized for several years following construction or addition of new turbines due to the time lags associated with sage-grouse population response to infrastructure (Manier et al. 2013, p. 60). – steppe habitats.

In mid-2009, wind energy production facilities in operation or under construction in the sage-grouse range had a capacity of 11.93 GW (AWEA 2009, entire). To achieve predicted levels of between 49 to greater than 90 GW capacity (DOE 2008, p. 10), the generation capacity would need to increase by 400 to 800 percent by 2030. Existing commercial wind turbines range from 1 to 4 MW generating capacity (AWEA 2013, entire). The forecasted increase in production would require approximately 37,000 to 78,000 or more turbines based on the existing technology and equipment in use. Assuming a generation capacity of 5 MW per km2 (0.4 mi2) density, Copeland *et al.* (2009, p. 1) estimated an additional 50,000 km2 (19,305 mi2) of land in the sage-grouse range would be required to meet the desired level of wind-generated electricity by 2030.Mud Spring Wind Ranch has announced the start of construction on its four-phase 240 MW, 120-turbine project on private land in Carbon County, Montana, which includes substation and transmission line construction. The lease size is approximately 10,049 ha (24,832 ac). This project location occurs in a PAC (as identified in the 2013 COT Report; Wyoming Basin population) and core sage grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

Montana-Dakota Utilities constructed, owns and operates the 30-MW Diamond Willow wind farm in Fallon County near Baker, Montana. Constructed in three phases between approximately 2007 and 2010, this wind farm consists of 20 1.5 MW wind turbines. This project occurs in a PAC (Dakotas population) and core sage-grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

The Energy Policy Act (Public Law 109–58, August 8, 2005) established a goal for the Secretary of the Interior to approve 10,000 megawatts (MW) of electricity from non-hydropower renewable energy projects located on public lands. States are also encouraging the development of renewable energy. For example the State of Nevada, through the Renewable Portfolio Standard, has mandated that investor-owned utilities generate, acquire, or save 20 percent of their produced electricity from renewable systems by 2015.

Although wind energy has been the fastest growing energy technology worldwide, achieving an annual growth rate of over 30 percent (BLM, 2014b), wind turbine construction within the sage-grouse range peaked in 2009 with 335 turbines constructed. Construction subsequently declined followed by an increase from 2012 to 2013 (Table X-).

Solar

Solar-generating systems have been used on a small scale to power individual buildings, small complexes, remote facilities, and signs. Commercial solar generation results in direct habitat loss, fragmentation, roads, powerlines, increased human presence, and disturbance during facility construction with likely similar effects to sage-grouse as reported with other energy development. Solar-powered electricity generation is increasing. The primary concerns with solar facilities are the large area necessary for solar panels (potential habitat loss) and water consumption (potentially affecting brood habitat; Manier et al. 2013, p. 66). Solar energy infrastructure is often ancillary to other development, and large-scale solar-generating systems have not yet contributed to any calculable direct habitat loss for sage-grouse; however, this may change as more systems come on line for commercial electricity generation. Solar energy systems require, depending on local conditions, 1.6 ha (4 ac) to produce 1 MW of electricity. For example, the 162-ha (400-ac) Nevada Solar One, the third largest solar electricity producer in the world, has a maximum potential of 75 MW from a 121-ha (300-ac) solar field (nevadasolarone.com 2008, entire). Between 2005 and the end of 2008, solar electricity generation increased from the equivalent of 66 trillion Btu to 83 trillion Btu (EIA 2009d, entire, NREL, 2013,p. v). The amount of solar power installed in the U.S. has increased from 1.2 GW in 2008 to an estimated 17.5 GW as of the end of the third quarter of 2014 (DOE, 2014b).

Geothermal

Impacts from geothermal energy development have not been studied due to the recent appearance of this type of development in sage-grouse habitat (Knick et al. 2011, p. ?) Geothermal energy production is similar to oil and gas development as it requires surface exploration, exploratory drilling, field development, and plant construction and operation (Manier et al. 2013, p. 70). Each drill site could disturb approximately 0.4 to 2.0 ha (1 to 5 ac)., and the drill rig could be approximately 15.2 meters (m) (60 feet (ft)) tall. The number of wells, and therefore potential loss of habitat, depends on the thermal output of the well and expected production of the plant (Suter 1978, p. 3). Direct habitat loss occurs from development of well pads, structures, roads, pipelines, and transmission lines. The development of geothermal energy requires intensive human activity during field development and operation (EIA 2009e, entire). The number of personnel required during construction varies significantly, but at any point there may be a few hundred laborers and professionals on-site with attendant vehicle traffic. The number of people required for routine operation of a power plant is typically three per shift; however, additional personnel (as many as 12 total, depending on plant size) may be on site during the day for maintenance and management (EIA 2009e, entire). Geothermal plants could be in remote areas necessitating housing construction, transportation, and utility infrastructure for employees and their families (Suter 1978, p. 12). Wells are drilled to access the thermal source and could take 7 to 60 days of continuous drilling (BLM 2007, pp. 2–4; BLM 2011, pp. 9, 15) depending on the depth of the well, and can potentially cause toxic gas releases depending on the geological formation (BLM 2013k, p. 427). The type and effect of these gases depends on the geological formation in which drilling occurs (Suter 1978, pp. 7–9). Water is necessary for drilling operations and later for condenser cooling at the generation plants, which are similar in size to coal- or gas-fired plants. Thus, local water depletions may be a concern for sage-grouse if they result in the loss of brood-rearing habitat. The BLM and USFS completed a programmatic EIS for geothermal leasing and operations across much of the western United States in 2008 (BLM and USFS 2008b, entire). Best management practices were included for minimizing the effects of geothermal development and operations on sage-grouse, but they are guidance only and general in nature (BLM and USFS 2008b, pp. 4.82–4.83).

Results of impact

Studies examining the impacts of renewable energy development on sage-grouse populations are limited. Renewable energy facilities typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly *et al.* 2004, pp. 7-40 to 7-41) will generally be similar to those discussed for nonrenewable energy development (see Oil & Gas, Mining, and Infrastructure Chapters).

Wind

Most published reports of the effects of wind development on birds focus on the risks of collision with towers or turbine blades (Pruett *et al.* 2009, p. 013136). Sage-grouse could be killed by flying into turbine rotors or towers (Erickson *et al.* 2001, entire) although reported collision mortalities have been few; average tower heights, flight elevations of sage-grouse, and diurnal migration habitats minimize the risk of collision. One sage-grouse was found dead within 45 m (148 ft) of a turbine on the Foote Creek Rim wind facility in south-central Wyoming, presumably from flying into a turbine (Young *et al.* 2003, Appendix C, p. 61). At wind farms in Wyoming, there have been 8 reported sage-grouse collision mortalities from 2009 through 2012, including one collision with a met tower located near a wind farm (USFWS 2015, pers.comm.). However, due to the sampling design for predicting mortality rates for these project areas, only a subset of the turbines were monitored for collision mortalities. Approximately, 30 percent of the turbines were searched, and searcher efficiency was approximately 60 to 70 percent. In addition, sage-grouse are more likely to be scavenged and removed from the search area before the search is conducted, it is unclear what level of mortality rates these fatalities represent (USFWS 2015, pers.comm.). For sage-grouse, the highest collision probabilities appear to occur when structures are located in areas where sage-grouse typically fly between foraging and loafing habitats. If the locations of such areas are known, impacts can be reduced by avoiding these areas when siting wind energy facilities (Johnson and Holloran 2010, p. 9). Preliminary data from research in Wyoming has indicated that direct mortality from collision occurs and may be greater than previously anticipated (USFWS 2015, pers. comm.).

LeBeau *et al.* (2014. p. ?) documents the short-term effects of wind energy infrastructure on sage-grouse habitat selection and on nest, brood, and female survival. Female survival did not appear to be related to distance to turbines, which is counter to research conducted in natural gas fields for sage-grouse and prairie-chickens (LeBeau *et al.* 2014, p. 528). This is likely related to high site fidelity inherent to sage-grouse (LeBeau *et al.*, 2014, p. 2). Sage-grouse nest and brood survival decreased in habitats in close proximity to wind turbines. Decreased nest and brood survival was likely the result of increased predation, which may have been a product of anthropogenic development and habitat fragmentation (LaBeau *et al.* 2014, p. 522). Sage-grouse are nesting in less risky habitats farther away from potential perches and in areas that have lower densities of small, medium, and large avian predators (Dinkins *et al.* 2014, p. 629). Despite sage-grouse fidelity, adult females with failed nests from the previous nesting season had lower nest site fidelity compared with females with successful nests. As in previous findings in response to disturbance, yearling birds had relatively larger changes in their spatial locations than adult birds whose spatial changes were at a smaller scale (Dinkins *et al.* 2014, p. 638). Sage-grouse habitat use patterns could be explained by areas of relatively greater predation over time leading to low sage-grouse productivity (Dinkins *et al.* 2014, p. 638). Sage-grouse are using direct and indirect mechanisms to avoid predators in habitat selection, possibly partially lowering their exposure to predation and nest predation (Dinkins *et al.* 2014, p. 629).

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Location and extent

~~*Table 11-5: Area of sagebrush habitat with wind energy development potential by management zone (Data from Service 2014)*~~

Wind

The maximum potential wind development scenario was constructed by the National Renewable Energy Laboratory (NREL), a DOE laboratory focused on research of renewable energy resources. NREL has modeled and mapped the wind resources in each of the states and assigned class designations to indicate the potential for wind power generation. Wind power classes range from 1 to 7; Class 7 has the highest potential wind power generation and Class 1 has the lowest. On the basis of projected wind technology development, NREL has determined that wind resources in Class 3 and higher could be economically developable over the next 20 years. All of the MZs exhibit areas where Class 3 through 7 have been modeled (Table X-4). Across MZs I and II, most of the wind resources are Class 3 and higher. However, in MZs VI, V, IV, III, and VII the wind resources are scattered and cover areas (Figure X-1). Due to advances in wind energy technology (NREL 2014, entire) developers may be able to put wind turbines in locations previously considered uneconomical, expanding into habitats they may not have previously considered for development.

Table ~~11-9~~X-4: NREL Wind Potential within GRSG 2015 Status Review Current Range Source: (Service, 2015)

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MZ	WPC 3 Acres	WPC3 % CR	WPC 4 Acres	WPC4 % CR	WPC 5 Acres	WPC5 % CR	WPC 6 Acres	WPC6 % CR	WPC 7 Acres	WPC7 % CR
1	23,941,216	50%	9,198,907	19%	1,530,751	3%	345,782	1%	56,692	0%
2	7,471,162	20%	3,412,153	9%	1,538,397	4%	1,080,381	3%	403,859	1%
3	476,699	2%	152,181	1%	61,528	0%	46,626	0%	26,840	0%
4	2,350,426	6%	498,516	1%	182,839	0%	81,459	0%	25,826	0%
5	1,153,113	6%	252,096	1%	92,930	0%	52,044	0%	22,545	0%
6	248,594	9%	94,480	3%	27,686	1%	6,757	0%	79	0%
7	3,918	0%	659	0%	130	0%	11	0%	1	0%

While the direct footprint of existing wind turbines in the range of sage-grouse is relatively small (7.3 km^2 [1800acres]; Manier et al. 2013, p. 60), the BLM has issued several ROWs in support of continued and future wind development t~~California and Nevada have more than 150 MW of developed wind capacity. An additional 828 to 1,080 MW are slated for development by 2014. California and Nevada have the potential to contribute nearly 1,080 megawatts of wind-generated energy. This amount of energy would provide enough energy for over 250,000 homes in California and Nevada.~~

~~There are 46,513 ha (114,936 ac) of wind energy ROWs in the planning area (Table X-10)~~hat may influence sage-grouse habitats (Table X-5). Actual development of these ROWs in to commercial facilities is not certain, and ROWs are most likely to be developed where there is access to transmission corridors (Manier et al. 2013, p. 61). There is ~~; however, there is~~ currently only one active industrial-scale wind energy generation facilities in the planning area (BLM 2013a, p. 104), the ~~—~~30-MW Diamond Willow wind farm in Fallon County near Baker, Montana. This wind farm consists of 20 1.5 MW wind turbines and is within a PAC (MZ I; Dakotas population).

We are ~~currently~~ aware of four preliminary, planning-stage wind project proposals in Montana (MZ I) that may encroach~~v(to a minor extent)~~ into sage-grouse habitat~~on general habitat polygons~~;

Comment [GS25]: current sage-grouse range?

Comment [DP26]: need to verify with GIS data.

Comment [DP27]: need to verify this is the one plant.

however, whether or not these proposals may be further refined, or even constructed, is unknown (USFWS 2015 pers . comm.). The 1,000 turbine Chokecherry/Sierra Madre proposed wind farm on 693 km^2 (171,251-acre) site in south-central Wyoming (MZ II) is within sage-grouse habitat (but outside of PAC), and is currently under NEPA review. In an~~We are not aware of additional wind projects specifically proposed in PACS (Figure X; THREATThe red dots represent currently constructed wind turbine locations).~~

~~Currently, the installed renewable energy capacity in Wyoming is 1,412 MW of wind energy, 0.05 MW of solar energy, and 0 MW of geothermal energy. A recent study, "Assessing the Potential for Renewable Energy on Public Lands~~ assessment of ~~," presented a nationwide overview of~~ renewable resources on BLM–administered lands . ~~In this study,~~ Wyoming was determined to have a high potential for wind-energy development ~~and a low potential for solar, and geothermal energy development. Wyoming's wind resource is (~~ ranked 8th in the nation; ~~(~~BLM 2013j, p. 3-52).

Comment [GS28]: check

Comment [DMD29]: Need to consistently apply this abbreviation, beginning at first mention.

Table ~~11-6~~X-5: Direct and Indirect effects (km2/-Acres) from wind energy ROWs in priority and general (as designated by BLM) sage-grouse habitats. (Indirect effects were calculated using the assumption that wind turbines attracted avian predators with a foraging range of 6.9 miles; ~~of Wind Energy ROWs in GRSG Habitat (~~Mariner et al. 2013, p. 62. No data were presented for MZ VI)

Management Zone ~~Entity~~	~~PPH SG Habitat~~Priority Habitat (km^2/~~A~~acres)	General Habitat (km^2/acres)
MZ I ~~–GP~~	47,090.8/11,636,400	140,276.2/34,663,000
~~BLM~~	~~5,808,000~~	~~4,524,900~~
~~Forest Service~~	~~5,808,000~~	~~515,300~~
~~Tribal and Other Federal~~	~~219,700~~	~~2,427,700~~
~~Private~~	~~7,132,500~~	~~24,682,800~~

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Management Zone Entity	PPH SG HabitatPriority Habitat (km2/Aacres)	General Habitat (km2/acres)
State	995,600	2,498,400
Other	1,900	13,900
MZ II and VII – WB & CP	70,722.9/17,476,000	77,700.5/19,200,200
BLM	9,021,200	9,012,500
Forest Service	162,000	452,500
Tribal and Other Federal	784,000	1,354,600
Private	6,233,900	7,394,800
State	1,244,800	979,800
Other	30,100	6,000
MZ III – SGB	40,583.9/10,028,500	16,066.4/3,970,100
MZ IV – SRP	88,749.9/21,930,600	44,347.5/10,958,500
BLM	13,710,700	4,928,200
Forest Service	1,613,800	1,113,500
Tribal and Other Federal	633,600	522,500
Private	4,890,200	3,516,742
State	1,019,373	846,200
Other	62,900	31,400
MZ V – NGB	2,872.1/7,097,20	23,504.1/5,808,000

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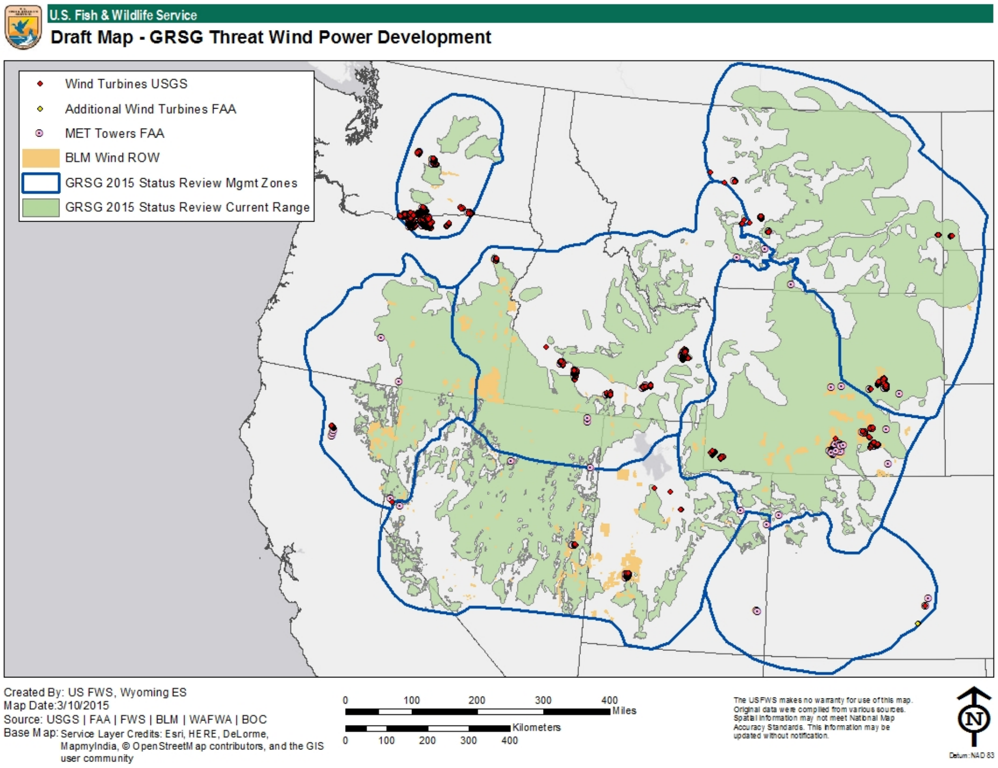

Solar

All currently constructed solar projects on Federal lands occur outside of priority sage-grouse habitats and affect XXX KM (Figure X-2, Table X-3). Currently ~~T~~there are ~~no~~two ~~existing renewable energy land use authorizations within the planning area within sage-grouse habitat (BLM, 2013b, p. 269).~~

~~Wind and solar resource facilities are permitted with ROWs through the Lands and Realty Program. All solar energy projects 20 MW and greater are excluded in all RMPs within the Northwest District, as described in the Solar Energy Development Programmatic EIS Record of Decision. Geothermal resources, as mentioned above, are considered fluid leasable minerals.~~ solar projects (NV,

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Comment [GS30]: Just priority or outside of all GrSG current range?

Comment [DP31]: need data from GIS to complete.

MZ III and OR, MZ V) within the range of sage-grouse (FWS GIS data). There are no current solar ROWs in sage-grouse habitats (BLM 2013h, p. 3-99), and therefore we have no data to suggest that further solar development in sage-grouse habitat on Federal lands is likely to occur. However, development on private lands is possible.

Comment [DP32]: need acreages

Although there are solar projects located in California and Nevada, there are no solar energy ROWs in the planning area (BLM, 2013a, p.105).

There are no existing renewable energy land use authorizations within the planning area within sage-grouse habitat (BLM, 2013b, p. 269).

Wind and solar resource facilities are permitted with ROWs, through the Lands and Realty Program. There are no active renewable energy ROW authorizations within the planning area (BLM, 2013g, p. 3-17).

There are currently no ROWs permitted for solar energy facilities in the planning area (BLM, 2013h, p.3-99).Table 11-11: Projected Megawatts of Solar Power Development by 2030 and Corresponding Developed Acreage Estimates for the RFDS[a] Source: (Service 2015, p. ?)

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Comment [GS33]: Are these calculations from the Service or from a BLM document?

State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDS[b]
California	BLM	15,421	138,789
	Non-BLM	5,140	46,260
Colorado	BLM	2,194	19,746
	Non-BLM	731	6,579
Nevada	BLM	1,701	15,309
	Non-BLM	567	5,103
Utah	BLM	1,219	10,971

State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDS[b]
	Non-BLM	406	3,654
Total	BLM	20535	184815
	Non-BLM	6844	61596

a See Appendix E of the Draft Solar PEIS for details on the methodologies used to calculate the RFDS.
b Acreage calculated assuming land use of 9 acres/MW (0.04 km2/MW). To convert acres to km2, multiply by 0.004047.

Comment [GS34]: Cite source?

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Table 11-10: NREL DNI Solar Potential within GRSG 2015 Status Review Current Range Source: (Service 2015, p. ?)

Comment [DMD35]: Is this table referenced in the document?

Need a better explanation of this table – assuming it is trying to show the potential for solar within each MZ? I think the map displays this information more concisely.

MZ	4.0 – 4.5	4-4.5 % CR	4.5 – 5.0	4.5-5 % CR	5.0 – 5.5	5-5.5 % CR	5.5 – 6.0	5.5-6 % CR	6.0 – 6.5	6-6.5 % CR	6.5 – 7.0	6.5-7 % CR	>7	
1	630,660	1%	21,183,967	44%	19,391,101	40%	6,439,559	13%	34,620	0%		0%		0%
2		0%	70,149	0%	5,198,950	14%	29,585,551	80%	2,261,177	6%		0%		0%
3		0%		0%	94,277	0%	2,728,948	9%	13,361,629	46%	8,567,929	30%	71,772	0%
4		0%	2,537,302	7%	9,993,144	26%	23,549,337	62%	2,133,349	6%		0%		0%
5		0%	25,610	0%	2,247,078	12%	11,689,016	61%	5,069,284	26%	246,984	1%		0%
6	81,879	3%	2,281,951	83%	394,079	14%		0%		0%		0%		0%
7	-	0%		0%		0%	333,679	28%	842,742	71%	4,007	0%	-	0%
Total:	712,539	0%	26,098,979	15%	37,318,629	21%	74,326,090	42%	23,702,801	13%	8,818,920	5%	71,772	0%

* Direct Normal Index (DNI) Solar Potential = NREL 10km DNI data for Concentrating Solar Resource

* NREL data measured in kWh/m2/Day

* Ranges above taken from NREL

The planning area has had no activity regarding solar energy projects, but this could change in the future (BLM, 2013k, p. 413).

No commercial solar plants are operating in sage-grouse habitats at this time. The PEIS for Solar Energy Development (2012) identified specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM proposes to prioritize development (and to apply any identified SEZ-specific design features), in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and

Utah). Solar Energy Zone are defined by the BLM as an area within which the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development. SEZs should be relatively large areas that provide highly suitable locations for utility-scale solar development: locations where solar development is economically and technically feasible, where there is good potential for connecting new electricity-generating plants to the transmission distribution system, and where there is generally low resource conflict (BLM, 2012, ES-7,8).

Table 11-7: Proposed SEZs and Approximate Acreage by State (BLM, 2012, p. ES-13)

Proposed SEZ (BLM Office/Country)	Approximate Acreage
Colorado	
Antonia Southeast (La Jara/Conejos)	9712
De Tilla Gulch (Saguache/Saguache)	1064
Fourmile East (La Jara/Alamosa)	2650
Los Mogotes (La Jara/Conejos)	2650
Total	16308
Nevada	
Dry Lake Valley North (Ely/Lincoln)	25069
Gold Point (Battle Mountain/Esmeralda)	4596
Millers (Battle Mountain/Esmeralda)	16534
Total	60395
Utah	
Escalante Valley (Cedar City/Iron)	6533
Milford Flats South (Cedar City/Beaver)	6252

~~Wah Wah Valley (Cedar City/Beaver)~~	~~5873~~
~~Total~~	~~18658~~
~~Total~~	~~248988~~

~~*GThere are over 799 major solar projects currently in the Solar Energy Industries Association database, representing over 43 GW of capacity. These projects have been constructed throughout the U.S. and occur on both private and public lands (SEIA 2014, p. ?). Because of the proprietary nature of this digitized information, we only have spatial data on the projects on Federal lands. All currently constructed solar projects on Federal lands occur outside of priority habitats.*~~

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~~*Source: NREL, 2010*~~

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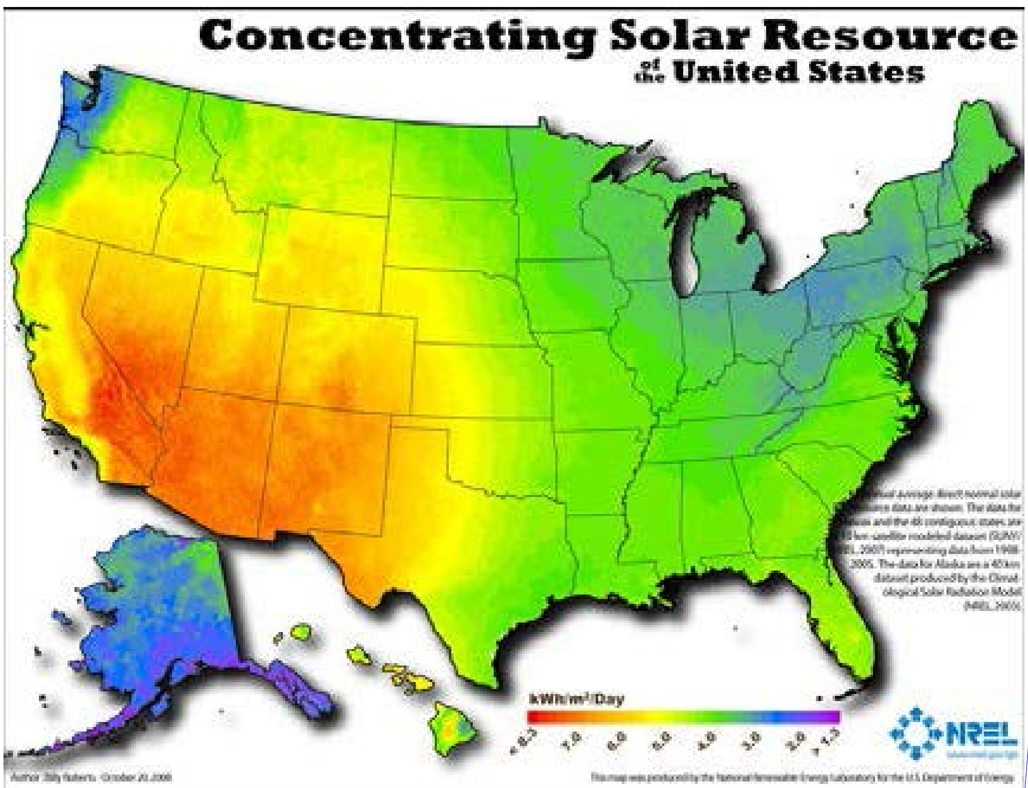

~~*Source: NREL, 2010*~~

~~G~~eothermal

Geothermal exploration and development activity on federal lands has been sporadic, due largely to economic factors. However, there has been a marked increase in geothermal interest. There are four current ~~G~~geothermal facilities ~~exsist~~ within the range of ~~the current~~ sage-grouse range (OR, ID, NV and UT; MZ III and IV; FWS 2015 data), totaling 57,384 ha (141,800ac.; Manier et al. 2013, p. 70). ~~in California (3 plants, MZ III), Nevada (5 plants, MZs III and V), Utah (2 plants, MZ III), and Idaho (1 plant, MZ IV). Since 2005, two additional plants were constructed in current sage-grouse range – one in Idaho and one in Utah (Geothermal Energy Association 2008, pp. 2-7). One existing geothermal plant in southern Utah is in the vicinity of sage-grouse habitat in an area where wind power is being considered for development (First Wind-Milford 2009, entire), which will result in cumulative impacts.~~

However, there are several approved geothermal leases on BLM lands throughout MZs III, IV and V (Table X-6). While these ROWs may not be currently developed the presence of a lease suggests the potential for future development. There are currently 25 federal leases for geothermal development~~?~~ in Idaho, covering approximately 24,281 ha (60,000 ac). Most of these ~~L~~leases are scattered across southern Idaho and 17~~, but are primarily located near Raft River, Crane Creek, two geothermal leases located on the north side of Magic Reservoir, there are geothermal leases located west of Weiser, and Parma, Idaho. There are no active leases currently in the Dillon Field Office. Seventeen of Idaho's 25 geothermal leases~~ are located in sage-grouse habitat. These leases ~~, and all~~ have existing stipulations protecting sage-grouse seasonal habitats ~~during critical seasons~~ ~~(as well as having stipulations to protect crucial habitat for other species)~~ (BLM 2013c, p. 3-103).

~~Geothermal exploration and development activity on federal lands in Idaho has been sporadic, due largely to economic factors. Idaho now has one 10 MW geothermal power plant currently~~

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Comment [DP36]: we need to decide if we are using ha or km2 for area

Comment [DP37]: need to verify with our GIS data

~~operating, as of 2007. It is located on private land at Raft River, south of Burley, Idaho. Nine federal leases surround the plant and extend up the southeast flank of Jim Sage Mountain. The BLM approved five geothermal drilling permits on a lease at Raft River in 2010, however no drilling has occurred to date. The drilling permits have several Conditions of Approval attached to protect wildlife. These include fencing reserve pits and safeguarding migratory birds from hazards associated with pits and treatment facilities, including but not limited to pit screening or netting, and placing protective cones over vent stacks. In addition, drilling is prohibited during the sage-grouse strutting and brood-rearing season (lease stipulation) (BLM, 2013c, p. 3-105).~~

~~There has been a marked increase in geothermal interest, including the recent development of a producing geothermal facility on private land in eastern Oregon. The Vale District has issued two ROWs for access to utilize geothermal resources on private mineral estate at the Neal Hot Springs Project. (BLM 2013h, pp. 3-99, 102).~~

~~Geothermal heat is also considered a leasable mineral and is governed by the Geothermal Steam Act of 1970.~~

Utah BLM currently has 59 authorized geothermal leases encompassing 65,642 ha (162,205 ac). ~~within the Fillmore and Cedar City Field Office areas of the southern half of Utah's West Desert.~~ As of early 2013, there were 41 geothermal wells in all of Utah, none of which are found in population areas or sage-grouse habitat. While there are several additional geothermal prospects being evaluated, ~~Currently, there are no geothermal energy production facilities within sage-grouse habitat. F~~future development of geothermal resources within sage-grouse habitat in Utah ~~the planning area~~ is ~~also~~ highly unlikely (BLM, 2013i, p. 3-18~~6~~4 – 3-186). There is no geothermal development in MZ I and II although geothermal potential is present across the specie's range (Table X-7, Figure X-3; Manier et al. 2013, p. 70).

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Comment [GS38]: what is a geothermal production facility? assuming a well does not qualify?

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Comment [GS39]: Unsure how this could be highly unlikely as there are existing wells.

Does this conflict with next paragraph?

Comment [DP40]: Need to verify this statement is specific to UT

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Table ~~11-13~~X-6: BLM Approved Geothermal Leases within GRSG 2015 Status Review Current Range (Service 2015, p. ?)

Management Zone	BLM Lease Acres	% of Current Range
1	0	0
2	0	0
3	322,593	1.12%
4	111,522	0.29%
5	74,098	0.38%
6	0	0
7	0	0
Total:	508,213	0.29%

Table X-7: Acres of Geothermal Resource Potential within GRSG Habitat (Manier *et al.* 2013, p. 71). No data were presented for MZ VI

Management Zone	Priority sage-grouse Habitat (km2/acres)	General sage-grouse Habitat (km2/acres)
MZ I	6,622/1,636,400	140,276/ 34,663,000
MZ II and VII	70,723/17,476,000	77,700/19,200,200
MZ III	40,584/10,028,500	137,472/33,970,100
MZ IV	88,750/21,930,600	44,347/10,958,500
MZ V	28,721/7,097,200	23,504/5,808,000

~~Geothermal resources are plentiful in the middle and northwest portions of the state, although a lack of transmission capacity may hinder electricity development in the northwest corner. Geothermal resources in Utah have the potential to supply 15,000 MW of electricity. The current installed capacity of Utah's two geothermal power plants is 42 MW. There are several additional geothermal prospects undergoing evaluation and exploration across the state (BLM, 2013i, p. *3-184*).~~

~~In South Dakota, interest in geothermal energy for space heating is a likely long-term trend, but is unlikely to affect Federal minerals. In addition, interest in commercial power generation has not been expressed in South Dakota (BLM 2013k, p. 420).~~

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Comment [GS41]: ? Is data from both sources?

Comment [DP42]: We originally had two tables of potential here - one from the BER and one from GIS calculations. We only need one and I may switch this one out once we have the update calculations from the GIS team. However, the original GIS table was very confusing and needs re-formatting.

Comment [DMD44]: Are these tables referenced in the document?
If data is taken from Service generated GIS data tables, probably need to reference different xcel documents as Service 2015a; 2015b; etc.

Comment [GS43]: Classes aren't defined anywhere – don't think we need this detail – consolidate and include in Table X-13 if needed.

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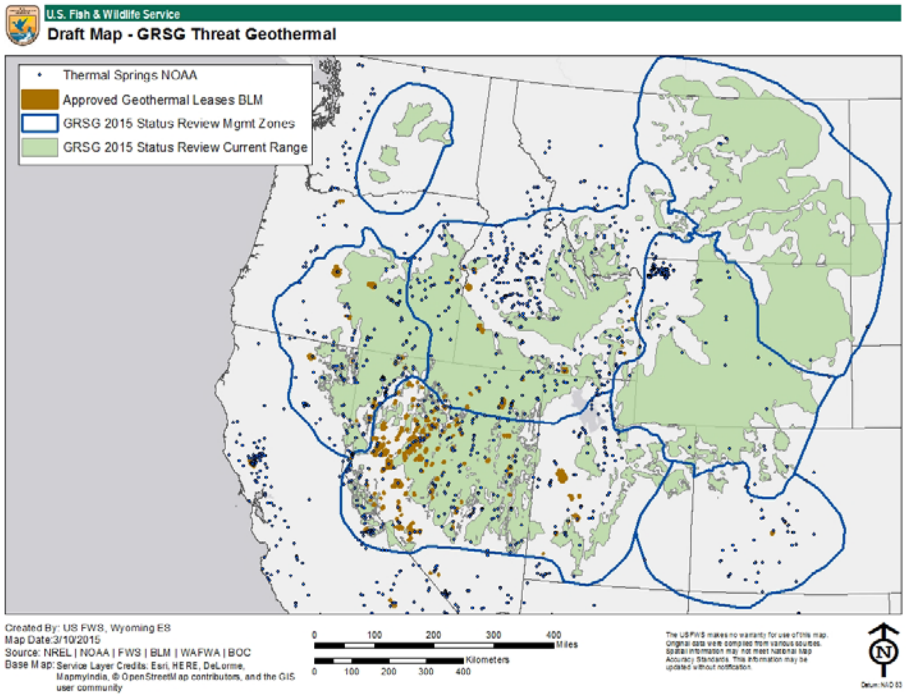

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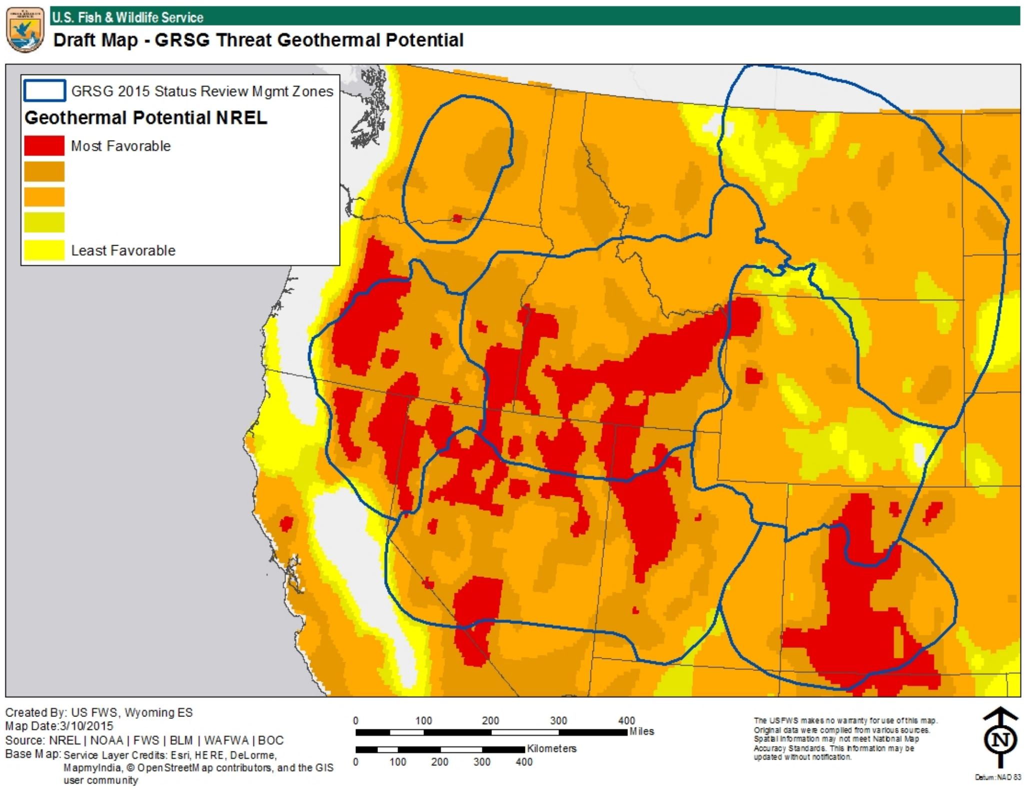

~~**Table 11-8: List of impacts by management zone**~~

~~Management Zone~~	~~Timing of Impacts (Season)~~	~~Immediacy of Impacts~~	~~Severity of Impacts~~	~~Extent of Impacts~~	~~Resource or Life stage impacted~~	~~Notes~~
~~**1 Wind**~~	~~Year-round~~	~~Now~~	~~Direct mortality, habitat destruction, Habitat~~	~~0~~	~~Nesting, broods,~~	

Management Zone	Timing of Impacts (Season)	Immediacy of Impacts	Severity of Impacts	Extent of Impacts	Resource or Life stage impacted	Notes
			avoidance			
2 Wind	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	1	Nesting, broods	
3 Wind, Geothermal **Solar**	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	1.77 0 0	Nesting, broods	
4 Wind, Geothermal	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	1.96 0	Nesting, broods	
5 Wind, Geothermal **Solar**	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	5.17 0 0	Nesting, broods	

Management Zone	Timing of Impacts (Season)	Immediacy of Impacts	Severity of Impacts	Extent of Impacts	Resource or Life stage impacted	Notes
6 Wind	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	0.01	Nesting, broods	
7 Wind	Year-round	Now	Direct mortality, habitat destruction, Habitat avoidance	2.40	Nesting, broods	

The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030. In order for this to occur, substantial growth of wind development will be required. Wind energy technology has been improving in two different ways, first to become more energy efficient turbines have gotten taller and blades longer to be able to capture wind in low potential areas. Larger rotors, taller towers, and better siting techniques have enabled wind developers to increase power production while simultaneously reducing costs (NREL 2014, entire). Energy developers will be able to put wind turbines in locations previously considered uneconomical, expanding into habitats they may not have previously considered for development.

Chapter 1: Map Showing Current THREATs (this is "Map 2" that the GIS team is working on; we will not have this map for all chapters)

Comment [DP45]: need a citation

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THREATProjected Future impacts

Wind

The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030. In order for this to occur, substantial growth of wind development will be required. Wind energy technology has been improving in two different ways, first to become more energy efficient turbines have gotten taller and blades longer to be able to capture wind in low potential areas. Larger rotors, taller towers, and better siting techniques have enabled wind developers to increase power production while simultaneously reducing costs (NREL 2014, entire). Energy developers will be able to put wind turbines in locations previously considered uneconomical, expanding into habitats they may not have previously considered for development.

The maximum potential development scenario (MPDS) was constructed by the National Renewable Energy Laboratory (NREL), a DOE laboratory focused on research of renewable energy resources. NREL has modeled and mapped the wind resources in each of the states and has assigned class designations to indicate the potential for wind power generation. Wind power classes range from 1 to 7; Class 7 has the highest potential wind power generation and Class 1 has the lowest. On the basis of projected wind technology development, NREL has determined that wind resources in Class 3 and higher could be economically developable over the next 20 years. All of the MZs exhibit areas where Class 3 through 7 have been modeled. Across MZs I and II, most of the wind resources are Class 3 and higher. However, THREATin MZs VI, V, IV, III, and VII the wind resources are scattered and cover areas (Figure X). In MZs I and II, most of these MZs have (Figure X).

In response to bird collisions wind companies are trying different techniques for bird deterrence and even detection such as: radar, GPS tracking, ultrasonic acoustics, designing new turbine shapes, forward looking infra-red camera (FLIR), and strike detection (Bevanger *et al.* 2008, entire; Drouin 2014, entire,). Unfortunately, information is lacking to demonstrate whether these methods are preventing bird collisions. Focusing new mitigation techniques on bird strikes does not address the more pertinent issues for sage-grouse, such as habitat fragmentation and habitat avoidance. Energy companies are trying to find mitigation practices that minimize the impacts to sage-grouse, however, as long as there are anthropogenic features on the landscape, habitat fragmentation and avoidance will still occur. Therefore, there is a high likelihood of continued future impacts in sage-grouse habitats due to renewable energy on the landscape into the foreseeable future.

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Table 11-9: NREL Wind Potential within GRSG 2015 Status Review Current Range Source: (Service, 2015)

MZ	WPC 3 Acres	WPC3 % CR	WPC 4 Acres	WPC4 % CR	WPC 5 Acres	WPC5 % CR	WPC 6 Acres	WPC6 % CR	WPC 7 Acres	WPC7 % CR
1	23,941,216	50%	9,198,907	19%	1,530,751	3%	345,782	1%	56,692	0%
2	7,471,162	20%	3,412,153	9%	1,538,397	4%	1,080,381	3%	403,859	1%
3	476,699	2%	152,181	1%	61,528	0%	46,626	0%	26,840	0%
4	2,350,426	6%	498,516	1%	182,839	0%	81,459	0%	25,826	0%
5	1,153,113	6%	252,096	1%	92,930	0%	52,044	0%	22,545	0%
6	248,594	9%	94,480	3%	27,686	1%	6,757	0%	79	0%
7	3,918	0%	659	0%	130	0%	11	0%	1	0%

Solar

The scope of the Final Programmatic Environmental Impact Statement for Solar Energy Development impact analysis includes an assessment of the potential environmental, social, and economic impacts of utility-scale solar facilities and required transmission connections from these facilities to the existing electricity transmission grid and other associated infrastructure such as roads over an approximately 20-year time frame (i.e., until about 2030) (BLM, 2012).

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Table X-11 presents the RFDS for each state in terms of projected MW and estimated acres of land required to support that level of development. The calculated number of BLM- and non-BLM-administered acres likely to be developed over the next 20 years is based on the assumed RFDS and on a high-end estimated land requirement of 9 acres/MW (0.04 km2/MW) for development (BLM 2012, p. 2-65). The estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period is about 24,000 MW, with a corresponding dedicated use of about 86,603 ha (214,000 ac) of BLM-administered lands. The estimated total amount of solar energy generation on all lands in the study area over the 20-year study period is 32,000 MW, with a corresponding dedicated use of about 115,538 ha (285,500 ac) of land (BLM 2012, p. ES-16).

We do not have enough information available to evaluate the scale of future impacts of solar power generation in sage-grouse habitats. Projects on federally administered lands will occur outside of sage-grouse habitats. However, there is uncertainty in whether these projects will be sighted on private lands within sage-grouse habitats. We have no information concerning proposed projects. We will continue to evaluate and monitor the impacts of solar power development in sage-grouse habitats as more information becomes available. We are not aware of any investigations reporting the impacts of solar generating facilities on sage-grouse or other gallinaceous birds.

Table 11-10: NREL DNI Solar Potential within GRSG 2015 Status Review Current Range Source: (Service 2015, p. ?)

MZ	4.0–4.5	4-4.5 % CR	4.5–5.0	4.5-5 % CR	5.0–5.5	5-5.5 % CR	5.5–6.0	5.5-6 % CR	6.0–6.5
1	630,660	1%	21,183,967	44%	19,391,101	40%	6,439,559	13%	34,620
2		0%	70,149	0%	5,198,950	14%	29,585,551	80%	2,261,177
3		0%		0%	94,277	0%	2,728,948	9%	13,361,629
4		0%	2,537,302	7%	9,993,144	26%	23,549,337	62%	2,133,349
5		0%	25,610	0%	2,247,078	12%	11,689,016	61%	5,069,284
6	81,879	3%	2,281,951	83%	394,079	14%		0%	
7	-	0%		0%		0%	333,679	28%	842,742
Total:	712,539	0%	26,098,979	15%	37,318,629	21%	74,326,090	42%	23,702,801

* Direct Normal Index (DNI) Solar Potential = NREL 10km DNI data for Concentrating Solar Resource

* NREL data measured in kWh/m2/Day

* Ranges above taken from NREL

Table 11-11: Projected Megawatts of Solar Power Development by 2030 and Corresponding Developed Acreage Estimates for the RFDS[a] Source: (Service 2015, p. ?)

State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDS[b]
California	BLM	15,421	138,789
	Non-BLM	5,140	46,260
Colorado	BLM	2,194	19,746
	Non-BLM	731	6,579
Nevada	BLM	1,701	15,309
	Non-BLM	567	5,103

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State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDS[b]
Utah	BLM	1,219	10,971
	Non-BLM	406	3,654
Total	BLM	20535	184815
	Non-BLM	6844	61596

~~a See Appendix E of the Draft Solar PEIS for details on the methodologies used to calculate the RFDS.~~
~~b Acreage calculated assuming land use of 9 acres/MW (0.04 km2/MW). To convert acres to km2, multiply by 0.004047.~~

~~Geothermal~~

Threat Amelioration ~~***A geothermal lease is issued for a primary term of 10 years and may be extended for two five-year periods. Each of these extensions is available provided the lessee meets the work commitment requirements or lessee made payment in lieu of minimum work requirements of each year. At any time a lease may receive a 5- year drilling extension. Once commercial production is established, the lease may receive a production extension of up to 35 years and a renewal period of up to 55 years. The lease must continue to produce to remain in effect. BLM may grant a suspension of operations and production on a lease when justified by the operator (see 43 CFR 3207) (BLM and USFS 2008, p. ?).***~~

~~***The geothermal leasing in the Western United States ROD (2008), did not provide any specific lease stipulations for the protection and conservation of sage-grouse. However, geothermal leases would be subject to same restrictions that are being developed by the BLM/USFS as part of the rangewide sage-grouse land use amendments for fluid mineral development. There is the potential for the likelihood of future impacts due to geothermal development within MZ II, III, IV, V, and VII. There is the potential for future impacts in MZ I but there are fewer geothermal resources identified for leasing***~~

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Comment [GS46]: Is there this information for the wind and solar permits?

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in this MZ. Geothermal development poses a widespread impact due to the extent of the development potential (Table X-14?).

Table 11-12: Acres of Geothermal Resource Potential within GRSG Habitat (Manier *et al.* 2013, p. 71)

Management Zone Entity	PPH SG Habitat (acres)	PPH SG Habitat (acres)
MZ I–GP	1,636,400	34,663,000
MZ II and VII–WB & CP	17,476,000	19,200,200
MZ III–SGB	10,028,500	33,970,100
MZ IV–SRP	21,930,600	10,958,500
MZ V–NGB	7,097,200	5,808,000

Table 11-13: BLM Approved Geothermal Leases within GRSG 2015 Status Review Current Range (Service 2015, p. ?)

Management Zone	BLM Lease Acres	% of Current Range
1	0	0
2	0	0
3	322,593	1.12%
4	111,522	0.29%
5	74,098	0.38%
6	0	0
7	0	0
Total:	508,213	0.29%

Table 11-14: NREL Geothermal Potential within GRSG 2015 Status Review Current Range Source: (Service, 2015)

	Most Favorable									Least Favorable
MZ	Class 1	Class 1 % CR	Class 2 Acres	Class2 % CR	Class 3 Acres	Class3 % CR	Class 4 Acres	Class 4 % CR	Class 5 Acres	Class5 % CR
1		0%	3,212,742	7%	37,586,886	78%	3,895,528	8%	1,417,934	3%
2	577,712	2%	2,334,455	6%	24,105,904	65%	7,914,169	21%	1,939,862	5%

	Most Favorable									Least Favorable
MZ	Class 1	Class 1 % CR	Class 2 Acres	Class 2 % CR	Class 3 Acres	Class 3 % CR	Class 4 Acres	Class 4 % CR	Class 5 Acres	Class 5 % CR
3	5,191,238	18%	12,675,295	44%	10,936,768	38%		0%		0%
4	16,520,232	43%	15,416,834	40%	6,239,141	16%	36,964	0%		0%
5	6,079,095	32%	11,591,848	60%	1,607,028	8%		0%		0%
6		0%	797,664	29%	1,960,245	71%		0%		0%
7	12,894	1%	74,838	6%	1,092,696	93%		0%		0%
Total:	28,381,171	16%	46,103,676	26%	83,528,668	48%	11,846,661	7%	3,357,796	2%

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~~The BLM recently completed a programmatic EIS on solar development in six southwestern States including Nevada and California, and through this process identified exclusion areas (or areas where solar development would not be allowed; BLM 2012b, p. ES-7).~~

~~Sage-grouse populations in existing wind developments are likely to see continued declines due to habitat fragmentation. Sage-grouse are subjected to predation pressures from mortality of adults, eggs, and chicks are moving out of the edge habitats to denser cover away from predators causing behavioral avoidance of previously suitable habitats (Dinkins *et al.* 2014, p. 640). Female sage-grouse are moving farther away from edge habitats and anthropogenic features as their nests and young are predated, yearling females are locating their nests at even greater distances (Dinkins *et al.* 2014, p.638). These behaviors will result in no further recruitment of sage-grouse in these habitats, changing life history strategies in previously functioning habitats.~~

~~It is unknown at this time to what extent geothermal development would occur within sage-grouse habitats. The geothermal leasing in the Western United States ROD (2008), did not provide any specific lease stipulations for the protection and conservation of sage-grouse In the BLM NV/CA sage-grouse~~

~~amendment (BLM, 2013a, p.2-37) there are 1,350,600 acres of sage-grouse habitat closed to geothermal development. However, there are 1,1600,100 acres open to geothermal development (BLM, 2013a, p.2-37). On BLM-administered lands in Utah there is a No Surface Occupancy (NSO) within 4 miles of occupied leks and Controlled Surface Use (CSU) in outside of 4-mile lek buffers. (p.2-155). In areas where geothermal development may occur, the BLM sage-grouse amendments are applying the stipulations subject to the oil and gas leasing, since geothermal leasing falls under that program area.~~

~~THREAT amelioration~~

Through the Conservation Efforts Database (CED), the Service collected information relating to conservation actions that were completed, in progress, or planned. Based on a summary report of that information created on XXXXXX, the following table indicates the number of actions and approximate areas for ~~THREAT~~ threat amelioration. These numbers are self-reported; the Service will further review and certify these actions if they are pivotal to any determination.

Time scale of threat

Given the incentives provided by EPCA, and state mandates, we anticipate the development of commercially viable renewable energy will continue indefinitely into the future. We also anticipate that the development of renewable energy sources will accelerate over current rates simply due to the completion of existing NEPA processes and approaching deadlines imposed by EPCA and other incentives.

Assessment of Potential ~~THREAT~~Threat

Comment [DP47]: need these data

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Comment [DMD48]: Per conversations on 2/26/2015- this should now include the following pieces:
•Quote 2010 conclusion (e.g. "We find that the threat of disease is not significant to the point that the greater sage-grouse warrants listing at this time.")
•What are the impacts at various scales:
oIndividuals
oPopulations
oManagement Zone
o"Range"
•Regulatory mechanisms may be ameliorating these impacts including x, y z. See cumulative effects and/or regulatory mechanisms chapter for further explanation.
•Based on the new science, we conclude that THIS STRESSOR is affecting the species in X way.
Language
•Avoid the terms "threatened or threatening" as a verb or adverb and "threat" as noun; may consider using:
oImpact
oStressor
oNegatively affecting
oNegligible impact (on its own), but could have cumulative impacts

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Sage-grouse could be killed by flying into turbine rotors or towers (Erickson *et al.* 2001, entire) although reported collision mortalities have been few. Behavioral avoidance, alteration of habitat quality, or changes in trophic interactions may have more important implications to sage- grouse population responses to wind energy development and could be more pervasive than direct effects of collisions (Winder *et al.* 2014, p. 2). In addition, sage-grouse are also being negatively impacted by the associated habitat loss and fragmentation that results from development (Dinkins *et al.* 2014, p. 640). The transmission line and road infrastructure associated with wind energy development has revealed behavioral impacts to sage-grouse (For further information see the chapter X infrastructure). Further, anthropogenic features such as roads, powerlines, fences and wind towers are linked to elevated mortality rates and shifts in life history strategies (Winder *et al.* 2014, p. 11).

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Habitat removal, fragmentation, and degradation is the primary THREAT threat to sage-grouse as a result of renewable energy development. While scientific literature specific to renewable energy development on sage-grouse is limited the infrastructure associated with wind, solar and geothermal extraction is similar to non-renewable energy extraction. Therefore, we expect the effects to sage-grouse and their habitats to be similarRecent studies on the impacts of predators in sage-grouse habitats show the common raven selects anthropogenic features and edge habitats for nesting and foraging. Female sage-grouse that have had nests predated are moving their nest locations, adult females at smaller increments than yearlings, suggesting that predation pressures are overriding female sage-grouse habitat site fidelity. Human manipulation of habitat that promotes increased densities of avian predators may limit sage-grouse populations, because habitat may become functionally unavailable to sage-grouse as avian predator densities increase (Dinkins *et al.* 2014, p. ?). The noise disturbance due to development also impacts sage-grouse abundance, stress levels, and behaviors causing sage-grouse to avoid areas impacted by noise. Habitat fragmentation and behavioral avoidance are occurring as a result of the associated infrastructure for renewable energy development (Pruett *et*

~~*al.* 2009, p. ?; Dinkins *et al.* 2014, p. 640). In addition, sage-grouse nest and brood survival is decreasing in habitats in close proximity to wind turbines (LeBeau *et al.* 2014, p.522). With the current technology, exclusion of these activities in sage-grouse breeding, nesting, foraging, and winter habitats is the only way to ensure this THREAT does not persist. Critics of this strategy may outline the economic losses incurred with such a plan, however, restricting development in sage-grouse priority habitats only reduces wind energy development by 1.82 percent with a reduction of 4 percent of wind energy profits (Macsalka, 2011, p. i). If exclusion of these activities in not enforced in the future, the development would be subject to the development restrictions of 1/640 and the 5% disturbance cap. These measures would limit the anthropogenic features on the landscape, however, they would still be permissible causing habitat removal, fragmentation, and degradation in the habitats in which they would occur.~~ .

Renewable energy resources are widely, but not evenly distributed across the range of sage-grouse. The extent of the resulting impacts will therefore not be equally distributed. Wind energy is the most developed of the renewable energy sources reviewed, and has the greatest potential for commercial expansion. Regulatory provisions at the Federal levels, if implemented, will limit future development in priority sage-grouse habitats (PACs and similar designations on Federal lands). However, these provisions don't extend to general habitats or supporting infrastructure, such as powerlines.

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Neither solar nor geothermal energy facilities currently have a large footprint within the range of sage-grouse and impacts are currently minimal. The potential for development of these resources appear limited at this time.

Our conclusions regarding renewable energy have not changed since our 2010 finding. While some additional development of all renewable energy resources discussed here has occurred, we did not find any information that suggested those additions have significantly contributed to loss of sage-grouse or their habitats since 2010. However, future development of wind resources is currently more imminent that reported in 2010.

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and growth of wind power development is expected to continue. The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030. To achieve this, substantial growth of wind developments will be required. With the advent of Federal tax credits for wind energy facilities, wind development increased 20 percent in 2013(Esterly and Gelman 2013, p. 3).

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Best management practices (BMPs) prescribed in the Wind Energy EIS (BLM, 2005, p.5-89-112) to minimize impacts of all phases of construction and operation of a wind production facility. The BMPs guide future project planning and do not guarantee protections specific to sage-grouse. We do not have information on how or where the EIS guidance has been applied since 2005 and cannot evaluate its effectiveness. The footprint of wind energy developments depends on how many turbines and infrastructure are necessary, for instance the Chokecherry Sierra Madre wind development project in WY developed a 171,251-acre site-specific Project Area to include areas in which CCSM Project components (infrastructure, wind turbines, etc.), this facility will have 1,000 turbine generators (BLM, 2014, p.1-2 and 1-3). Areas of commercially viable wind generation have been identified by the NREL (2008b, entire) and BLM (2005, p. 2.4) in all 11 States in the sage-grouse range.

In MZ I, II, III, IV, V, VII the BLM/FS lands are precluding wind and solar development in priority habitat (Table X-3). Primarily ROW permitting for wind and solar energy facilities will be designated as exclusion areas. These designations will presumably cause no impacts due to wind and solar development with the assumption that there will be no exemptions to the exclusion of wind and solar energy developments in areas with this designation. However, transmission lines have both exclusion and avoidance areas within all of the MZs. (The definitions of avoidance and exclusion can be found on p. 1-34 after the Summary of BLM/USFS Draft RMP/EIS Wind/Solar Energy Actions table). The intent of an avoidance designation is to primarily exclude projects, however permits may be granted under an avoidance designation which allows for more flexibility for the Authorizing Officer (AO; e.g., Field Manager, District Ranger, District Manager, etc.). Even with these management actions in place there is still a widespread THREAT present because it is unknown to what extent and where transmission projects may occur, and under which circumstances they may occur.

Comment [DMD49]: Insert as footnote?

The BLM and USFS are proposing to exclude wind development in priority habitats until there are no longer impacts to sage-grouse populations. Some plans are extending this protection to ROW exclusion, which will cause no impacts due to wind and solar development with the assumption that there will be no exceptions to these designations. Many of the plans have designated areas as avoidance for transmission lines, which may have ROW permits granted at any time in the future. The exclusion designations provides protections for sage-grouse from wind turbines, however cross county transmission lines and roadways could still be constructed under an avoidance designation, creating habitat fragmentation, behavioral avoidance, and change life history strategies for sage-grouse. (Table X).

The Solar EIS recognized occupied sage-grouse habitat as a criterion for exclusion of solar energy development.

Comment [DMD50]: Is something missing here? Is there more to develop?

Comment [GS51]: Move to Reg Mechs, if needed.

Table 11-15: List of Conservation Efforts (ameliorating THREAT described in this chapter) by management zone

Management Zone	Type of Conservation Effort	Sum of Acres or Miles	Number of Actions	Notes
1				
2				
3				
4				

Management Zone	Type of Conservation Effort	Sum of Acres or Miles	Number of Actions	Notes
5				
6				
7				
8				

THREAT Amelioration Summary

Table 11-16: Summary of BLM/USFS Draft RMP/EIS Wind/Solar Energy Actions

Comment [DMD52]: Move to reg. mechs. section?

NV and NE CA Draft RMP/EIS		
	Exclusion	Avoidance
ROW exclusion areas on BLM and Forest Service-administered lands within PPH, PPMA, or SGMA (occupied) (144,200 acres) (p.2-36)	X	
ROW exclusion areas on BLM and Forest Service-administered lands within PGH, PGMA, or SGMA (suitable) (37,000 acres) (p.2-36)	X	
Solar energy ROW variance area within PPH, PPMA, or SGMA (occupied) 10,655,300 acres (p.2-36)		X
Solar energy ROW variance area within PGH, PGMA, or SGMA (suitable) 2,295,500 acres (p.2-36)		X

Fluid Mineral Leasing (oil and gas and geothermal)		
Closed to fluid mineral leasing within PPH, PPMA, or SGMA (occupied) 1,161,500 acres (p.2-37)		
Closed to fluid mineral leasing within PGH, PGMA, or SGMA (suitable) 189,100 acres (p.2-37)		
Open to fluid mineral leasing within PPH, PPMA, or SGMA (occupied) 9,493,800 acres (p.2-37)		
Open to fluid mineral leasing within PGH, PGMA, or SGMA (suitable) 2,106,300 acres (p.2-37)		
Open to fluid minerals but requires application of the avoid, minimize and mitigation evaluation in SGMA (occupied) 9,493,800 acres (p.2-37)		
Open to fluid minerals but requires application of the avoid, minimize and mitigation evaluation in SGMA (suitable) 2,106,300 acres (p.2-37)		
NW CO Draft RMP/EIS		
ROW Designation in PPH for large transmission lines on 68,000 acres (p.146)		X
ROW Designation in PPH for large transmission lines on 881,000 acres (p.146)	X	
Geothermal (is managed as a fluid leasable mineral) Unleased Fluid Minerals **GRSG PPH NSO-46d.** Apply NSO stipulation for fluid mineral leasing in PPH. **GRSG ADH NSO-46d.** Apply NSO stipulation for fluid mineral leasing in ADH within a minimum distance of 0.6-mile from active leks. **GRSG ADH TL-46d.** Within ADH, prohibit surface occupancy within a minimum of 4 miles from active leks during lekking, nesting, and early brood rearing. **Ecological Sites that Support Sagebrush in PPH CSU-46d.** Surface disturbance within ecological sites that support sagebrush in PPH would not exceed 5 percent within the		

corresponding Colorado MZ. See **Appendix E**, Stipulations Applicable to Fluid Mineral Leasing and Land Use Authorizations and **Appendix F**, Disturbance Cap Management. (p.161)
Leased Fluid Minerals **GRSG PPH COA-47-51d.** Prohibit surface occupancy or disturbance within 4 miles of a lek during lekking, nesting, and early brood rearing. **GRSG Ecological Sites that Support Sagebrush in PPH COA-47-51d.** Limit permitted disturbances to 5 percent in any Colorado MZ. **GRSG PPH COA-47-51d.** Prohibit surface occupancy or disturbance within 4 miles of a lek during lekking, nesting, and early brood rearing. **GRSG Ecological Sites that Support Sagebrush in PPH COA-47-51d.** Limit permitted disturbances to 5 percent in any Colorado MZ. **GRSG PPH COA-47-51d.** Prohibit surface occupancy or disturbance within 4 miles of a lek during lekking, nesting, and early brood rearing. **GRSG Ecological Sites that Support Sagebrush in PPH COA-47-51d.** Limit permitted disturbances to 5 percent in any Colorado MZ. **GRSG PPH COA-47-51d.** Prohibit surface occupancy or disturbance within 4 miles of a lek during lekking, nesting, and early brood rearing. (See **Table 2.5**, Existing Habitat Timing Limitations by Field Office.) **GRSG Ecological Sites that Support Sagebrush in PPH COA-47-51d.** Limit permitted disturbances to 5 percent in any Colorado MZ. **GRSG PPH COA-47-51d.** Prohibit surface occupancy or disturbance within 4 miles of a lek during lekking, nesting, and early brood rearing. (See **Table 2.5**, Existing Habitat Timing Limitations by Field Office.) **GRSG Ecological Sites that Support Sagebrush in PPH COA-47-51d.** Limit permitted disturbances to 5 percent in any Colorado MZ. **GRSG PPH Notice to Lessees-54d.** Within PPH, complete Master Development Plans instead of single-well Applications for Permit to Drill for all but exploratory wells. GRSG PPH COA-55d. For leases that are not yet developed, the proposed surface disturbance cannot exceed 5 percent for ecological sites that support sagebrush in PPH for that Colorado MZ **GRSG PPH Notice to Lessees-58d**. Encourage unitization within Colorado MZs when necessary for proper development and operation of an area or to facilitate more orderly (i.e., phased and/or clustered) development as a means of minimizing adverse impacts to GRSG. (ADH) For future actions, require a full reclamation bond specific to the site in accordance with 43 CFR 3104.2, 3104.3, and 3104.5. Ensure bonds are sufficient for costs relative to reclamation (Connelly *et al.* 2000a;

~~Hagen *et al*. 2007) that would result in full restoration of the lands to the condition it was found prior to disturbance. Base the reclamation costs on the assumption that contractors for the BLM and USFS will perform the work. (p.162)~~		
~~ID and SW MT Draft RMP/EIS~~		
~~**PPMA:** Solar and wind energy development is not allowed. (p.2-161)~~	~~X~~	
~~**PMMA:** Wind and solar energy development would be restricted where adverse effects could not be mitigated. Ancillary facilities such as roads, electric lines, etc. could potentially be authorized provided there is no net loss of GRSG habitat through mitigation (p.2-161, 162).~~		~~X~~
~~**PGMA:** Lands shall be considered avoidance areas for wind and solar development. (p.2-162)~~		~~X~~
~~Designate PPMA as ROW Avoidance areas and exclusion areas for wind and solar development .~~ ~~New authorizations for the following uses are not allowed: Transmission facilities (greater than 50kV in size), wind energy testing and development, commercial solar development, commercial geothermal development, nuclear development, oil and gas development, mineral development, airports, and ancillary facilities associated with any of the aforementioned development; paved roads and graded gravel roads, landfills, airports, and hydroelectric projects. Communication sites would be allowed. (p.2-162)~~	~~X~~	~~X~~
~~**PMMA:** Designate PMMA as ROW Avoidance areas. Access roads or loop roads would be addressed during the ROW authorization processing and on a case-by-case basis. (p.2-162)~~		~~X~~

PGMA: Same as PMMA. (p.2-162)		X
ROW Designation in Idaho-CHZ (p.2-162)		X
ROW Designation in Idaho-IHZ (p.2-162)		X
MT-HiLine Draft RMP/EIS		
ROW Designation for Commercial Wind Energy Development of 885, 661 acres		X
ROW Designation for Commercial Wind Energy Development of 1,518,695 acres	X	
BLM lands in the planning area will be available for geothermal leasing, unless located within the Burnt Lodge or Bitter Creek WSAs or in instances where it is determined that issuing the lease would cause unnecessary or undue degradation to BLM lands or resources.		
Opportunities for solar development will be provided consistent with the other goals, objectives, and requirements of this plan. Applications for solar energy projects will be processed and authorized as rights-of-way. Utility-scale concentrating solar power or photovoltaic electric generating facilities must comply with the BLM's planning, environmental, and right-of-way application requirements as established by BLM guidance (WO IM No. 2011-003) or additional Bureau guidance and/or policy.		
MT-Miles City Draft RMP/EIS		
Renewable energy ROW (wind and solar) of 1.2 million acres (p.2-6)		X
Renewable energy ROW (wind and solar) of 12,000 acres (p.2-6)	X	
Geothermal leasing would be offered in compliance with the Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States(p.2-40)		
MT-Billings Resource Management Plan and EIS		

Renewable Energy (wind and solar) on 78,088 acres (p.2-21)	X	
Renewable Energy (wind and solar) on 331,088 acres (p.2-22)		X
Lands in the planning area would be available for geothermal leasing, unless located within wilderness or WSAs or in instances where it is determined that issuing the lease would cause unnecessary or undue degradation to public lands or resources. Other areas that would be made unavailable are listed in the Record of Decision and RMP Amendments for Geothermal Leasing in the Western United States (December, 2008) which is incorporated in this RMP. A site-specific environmental analysis would be prepared as needed should interest be expressed in exploring for or developing geothermal resources in the planning area. This analysis would address the application of stipulations and develop any additional mitigating measures over and above the lease stipulations required. (p.2-101)		
ND Greater sage-grouse Draft RMPA/EIS		
ROW Designation in PH on 32,000 acres (p.2-27)	X	
ROW Designation in PH on 80 acres (p.2-27)		X
There are no geothermal resources within the ND Greater sage-grouse Draft RMPA/EIS planning area. (p.3-29)		
Oregon Sub-Region Greater sage-grouse Draft RMP/EIS		
Exclusion Area: PPH/PPMA/Core Area habitat (257,154 acres). (p.2-53)	X	
Exclusion Area: PGH/PGMA/Low Density habitat (288,195 acres) (p.2-53)	X	
Avoidance Area: PPH/PPMA/Core Area habitat (4,289,889 acres) (p.2-53)		X
Avoidance Area: PGH/PGMA/Low Density habitat (1,672,025 acres) (p.2-53)		X
Leasable Minerals – Leased Federal Fluid Mineral Estate (Including Geothermal) (MLS) In PPMA, apply the following conservation measures through RMP implementation decisions (e.g., approval of an Application for Permit to Drill and Sundry Notice) and upon completion of the environmental record of		

~~review (43 CFR 3162.5), including appropriate documentation of compliance with NEPA. In this process evaluate, among other things:~~ ~~1. Whether the conservation measure is "reasonable" (43 CFR 3101.1-2) with the valid existing rights~~ ~~2. Whether the action is in conformance (p.2-94)~~ ~~Additionally, apply the 3% disturbance limitation for development within PPMA. Issue Written Orders of the Authorized Office requiring reasonable protective measures consistent with the lease terms where necessary to avoid or minimize impacts on GRSG populations and its habitat. Include actions in the authorization that would minimize habitat loss and promote restoration of habitat when development activities cease in areas where GRSG populations have been substantially diminished and where few birds remain. (p.2-94)~~		
~~South Dakota Draft RMP/EIS~~		
~~Renewable energy ROWs within Sage-grouse PPAs and areas outside of PPAs within 4.0 miles of leks, sage-grouse wintering areas 55,761 acres (p.59)~~	~~X~~	
~~Renewable energy ROWs within Sage-grouse nesting and brood rearing areas outside of PPAs 84,384 acres (p.57)~~		~~X~~
~~Oil and gas stipulations as described by each alternative would also apply to geothermal exploration and development.~~		
~~Utah Greater Sage-grouse Draft LUPA/EIS~~		
~~PPMAs Designation for Wind Energy Development 2,760,300 acres (p.2-105)~~	~~X~~	
~~PPMAs Designation for Wind Energy Development 9,400 acres (p.2-105)~~		~~X~~
~~Wind Energy Development outside of GRSG habitat 82,400 acres (p.2-106)~~	~~X~~	
~~Wind Energy Development outside of GRSG habitat 462,500 acres (p.2-106)~~		~~X~~
~~Areas outside PPMAs but within 1.0 mile of an occupied lek,~~	~~X~~	

if the lek is located within a PPMA (p.2-106)		
Areas outside PPMAs but within 4 miles of an occupied lek located within a PPMA (p.2-106)		X
wind energy development within 1.0 mile of an occupied lek located in PGMA (p.2-106)	X	
Above-ground Site-type ROWs/SUAs (non-wind or solar) Avoided 51,700 acres (p.2-94)		X
Above-ground Site-type ROWs/SUAs (non-wind or solar) Excluded 81300 acres (p.2-94)	X	
Geothermal: NSO within 4 miles of occupied leks. CSU/TL in outside of 4-mile lek buffers. (p.2-155)		
Wyoming Sage-grouse Land Use Plan Amendment		
New ROW or SUA permits within Sage-grouse core habitat areas (p.2-18)		X
sage-grouse general habitat areas (p.2-20)		X
Wind energy development within sage-grouse core habitats (p.2-30)	X	
Geothermal: Leasing of non-energy leasable minerals would be considered within sage-grouse core habitat areas, except in areas that are unavailable for leasing due to the need to protect sensitive resources Exploration licenses and prospecting permits would be considered with appropriate mitigating measures. All non-energy leasable mineral activities would be considered in sage-grouse core habitats, provided that the activities can be completed in compliance to surface occupancy and disturbance and density stipulations analyzed through the DDCT process. (p.2-86)		

Glossary

Avoidance/avoidance area. These terms usually address mitigation of some activity (i.e., resource use). Paraphrasing the CEQ regulations (40 CFR 1508.20), avoidance means to circumvent, or bypass, an impact altogether by not taking a certain action, or parts of an action. Therefore, the term "avoidance" does not necessarily prohibit a proposed activity, but it may require the relocation of an action, or the total redesign of an action to eliminate any potential impacts resulting from it. Also see *"right-of-way avoidance area"* definition.

Exclusion area. An area on the public lands where a certain activity(ies) is prohibited to insure protection of other resource values present on the site. The term is frequently used in reference to lands/realty actions and proposals (e.g., rights-of-way, etc.), but is not unique to lands and realty program activities. This restriction is functionally analogous to the phrase "no surface occupancy" used by the oil and gas program, and is applied as an absolute condition to those affected activities. The less restrictive analogous term is avoidance area. Also see *"right-of-way exclusion area"* definition.

Comment [DMD53]: Include with footnote – see comment above.

Assessment of Potential THREAT

Sage-grouse could be killed by flying into turbine rotors or towers (Erickson et al. 2001, entire) although reported collision mortalities have been few. Behavioral avoidance, alteration of habitat quality, or changes in trophic interactions may have more important implications to sage- grouse population responses to wind energy development and could be more pervasive than direct effects of collisions (Winder et al. 2014, p. 2). In addition, sage-grouse are also being negatively impacted by the associated habitat loss and fragmentation that results from development (Dinkins et al. 2014, p. 640). The transmission line and road infrastructure associated with wind energy development has revealed behavioral impacts to sage-grouse (For further information see the chapter X infrastructure). Further, anthropogenic features such as roads, powerlines, fences and wind towers are linked to elevated mortality rates and shifts in life history strategies (Winder et al. 2014, p. 11).

Comment [DMD54]: Per conversations on 2/26/2015- this should now include the following pieces:
•Quote 2010 conclusion (e.g. "We find that the threat of disease is not significant to the point that the greater sage-grouse warrants listing at this time.")
•What are the impacts at various scales:
oIndividuals
oPopulations
oManagement Zone
o"Range"
•Regulatory mechanisms may be ameliorating these impacts including x, y z. See cumulative effects and/or regulatory mechanisms chapter for further explanation.
•Based on the new science, we conclude that THIS STRESSOR is affecting the species in X way.
Language
•Avoid the terms "threatened or threatening" as a verb or adverb and "threat" as noun; may consider using:
oImpact
oStressor
oNegatively affecting
oNegligible impact (on its own), but could have cumulative impacts

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Comment [GS55]: ?

~~*Habitat removal, fragmentation, and degradation is the primary THREAT to sage-grouse as a result of renewable energy development. Recent studies on the impacts of predators in sage-grouse habitats show the common raven selects anthropogenic features and edge habitats for nesting and foraging. Female sage-grouse that have had nests predated are moving their nest locations, adult females at smaller increments than yearlings, suggesting that predation pressures are overriding female sage-grouse habitat site fidelity. Human manipulation of habitat that promotes increased densities of avian predators may limit sage-grouse populations, because habitat may become functionally unavailable to sage-grouse as avian predator densities increase (Dinkins et al. 2014, p. ?). The noise disturbance due to development also impacts sage-grouse abundance, stress levels, and behaviors causing sage-grouse to avoid areas impacted by noise. Habitat fragmentation and behavioral avoidance are occurring as a result of the associated infrastructure for renewable energy development (Pruett et al. 2009, p. ?; Dinkins et al. 2014, p. 640). In addition, sage-grouse nest and brood survival is decreasing in habitats in close proximity to wind turbines (LeBeau et al. 2014, p.522). With the current technology, exclusion of these activities in sage-grouse breeding, nesting, foraging, and winter habitats is the only way to ensure this THREAT does not persist. Critics of this strategy may outline the economic losses incurred with such a plan, however, restricting development in sage-grouse priority habitats only reduces wind energy development by 1.82 percent with a reduction of 4 percent of wind energy profits (Macsalka, 2011, p. i). If exclusion of these activities in not enforced in the future, the development would be subject to the development restrictions of 1/640 and the 5% disturbance cap. These measures would limit the anthropogenic features on the landscape, however, they would still be permissible causing habitat removal, fragmentation, and degradation in the habitats in which they would occur.*~~

Comment [GS56]: None of this is really summary imformation.

~~*and growth of wind power development is expected to continue. The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030. To achieve this, substantial growth of wind developments will be required. With the advent of Federal tax credits for wind energy facilities, wind development increased 20 percent in 2013(Esterly and Gelman 2013, p. 3).*~~

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